

SAJOUS'S
ANALYTIC CYCLOPEDIA
OF
PRACTICAL MEDICINE

BY
CHARLES E. de M. SAJOUS, M.D., LL.D., Sc.D.

AND
LOUIS T. de M. SAJOUS, B.S., M.D.

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CONTRIBUTORS TO VOLUME VII

ADLER, LEWIS H., JR., M.D.

ARNOLD, J. O., M.D.

BARNES, CHARLES S., A.B., M.D.

BELL, ALBERT J., A.B., M.D.

BLAND, P. BROOKE, M.D.

BONDURANT, EUGENE D., M.D.

CARPENTER, HOWARD CHILDS, M.D.

DOYLE, GEORGE F., M.D.

FREEMAN, FRANK E., M.D.

GLEASON, EDWARD B., B.S., M.D., LL.D.

GOEPP, R. MAX, M.D.

JACKSON, EDWARD, A.M., M.D., Sc.D.

KIRBY, ELLWOOD R., M.D.

LE BOUTILLIER, THEODORE, M.D.

SAJOUS, CHARLES E. DE M., M.D., Sc.D., LL.D.

SAJOUS, LOUIS T. DE M., B.S., M.D.

TAYLOR, J. MADISON, A.B., M.D.

WILLARD, DE FOREST P., B.S., M.D.

WITHERSTINE, C. SUMNER, M.S., M.D.

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SAJOUS'S

ANALYTIC CYCLOPEDIA

of PRACTICAL MEDICINE

N

NEURASTHENIA.—DEFINITION.—A disease to which Beard, of New York, first called attention, in 1869, characterized by functional exhaustion of the tissues, especially those of the nervous system, due to excessive or undue waste of nervous energy, psychic or motor, and in some cases to autointoxication.

SYMPTOMS.—The salient symptom of neurasthenia is fatigue, or muscular weakness, often varying in degree with the duration of the case, but usually excessive and persistent. The patient complains of feeling "very tired" and of being unable to do mental labor, the least concentration being followed by vertigo, headache, etc. It is characteristic of this sense of fatigue that it is in simple and typical cases always relieved or lessened by rest, and always brought on, if absent, or made worse, if present, by exertion. According to Dercum this readiness of fatigue is the primary and fundamental symptom of neurasthenia. The patient often shows a remarkable diminution of strength, as shown by the hand dynamometer, or in lifting, even though he may be capable of exerting a sudden show of force. He is incapable of

sustained effort. Backache, probably a fatigue symptom, is often complained of. It is relieved by rest.

Soldiers in active service are subjected to all sorts of shock and strain; hence, many functional phenomena occur, *e.g.*, constriction of visual fields, amaurosis, aphonia, deafness, various forms of paralysis, etc. Some, after shock or strain, show essentially the symptoms of fatigue and abulia, the symptoms especially characteristic of true neurasthenia. Besides these essential symptoms, many others occur, which often lead to much confusion in diagnosis. Among these are vertical or posterior headache, increased by exertion, diminished by rest. Hyperacousis is common, and may render music repugnant. Photophobia or diminution in the acuity of vision is often associated with fatigue. Neurasthenics are morbidly conscious of visceral movements and become morbidly anxious. Pains in the neck, back, or extremities may be very severe and defy all means of relief. Muscular tremors, especially of the facial muscles and eyelids, are very common. The knee jerks may be decreased or normal, but more often increased. Testing the reflexes may give rise to more or less extensive disagreeable sensations or an emotional state. Col. H. T. Tooth (*Birmingham Medical Review*, Nov.-Dec., 1917).

In the history of a case of neurasthenia or neurosis many symptoms other than the so-called nervous are brought out. Thus, one is told that the heart palpitates, the bowels are constipated, there is pain around the heart, feelings of faintness with or without exertion, flatulence, insomnia, nightsweats, inability to eat the average meal, feelings of vague fear as if something awful was about to happen; constant lassitude, especially in the morning and in spite of enough sleep; unpleasant dreams; tinglings and aching in the limbs, inability to make decisions, special phobias, and other conditions. H. W. Wright (*Med. Jour. and Rec.*, Sept. 1, 1926).

Another manifestation of muscular weakness is tremor. Short spasmodic contractions of isolated groups of muscular fibers and aimless movements of the extremities that suggest, when facial muscles are involved, chorea. The tendon reflexes, including the knee-jerk, are increased in the majority of cases. Fine muscular tremors are often observed, especially of the orbicularis oris and the lingual muscles. Most patients complain of trembling knees and shaking hands, the last symptom being often noticeable in the handwriting.

The headache, one of the most common symptoms, varies in intensity from a sensation of heaviness on the top of the head, or fullness, to a feeling compared by some patients to that which an iron band tightly constricting the head might produce. It is often occipital. This is especially marked after intellectual labor, and often disappears after the latter ceases. It may also be caused by muscular effort or an emotion.

The appearance of the patient does not always denote the existence of the neurasthenic state; indeed, his general mien may suggest perfect

health. In the majority of cases, however, there are pallor and an unmistakable appearance of weariness. Loss of weight and anemia are often present, and occasionally the physical debility is so great as to keep the patient in bed.

Insomnia is frequently complained of by neurasthenics, or the sleep is disturbed. If sound, the patient awakens unrefreshed and even more fatigued sometimes than when he retired. Dreams of an unpleasant kind are common; they sometimes reach the intensity of dreadful nightmare.

The mental disturbances of the neurasthenic may be summarized by the phrase "weakness and irritability." The capacity for work is reduced and the muscular power correspondingly so. Even thinking or reading, which involve the necessity of fixing attention, is irksome. Amnesia, general and verbal, weakness and indistinctness of speech, irritability, fretfulness, and hypochondria, sometimes reaching to melancholia and suicidal tendencies, are sometimes witnessed. Mental aberration is suggested by many petty acts which the patient in his normal state would not have perpetrated. Indeed, he may become tyrannical, envious, jealous, and even cruel. Curious perversions of mental activity are witnessed, mental pictures and various thoughts succeeding one another with rapidity, while a name, a sentence, a time, etc., will for hours and even days recur constantly to the patient's mind. Through a misinterpretation of his symptoms, he deems himself the victim of many diseases, while in reality suffering only from nosophobia.

Again, he may constantly be dread-

ing falls, especially when near an open space, such as the top of a staircase, or experience a sense of suffocation upon the least excitement or unusual incident of everyday life. Courage is very deficient, owing to the loss of psychic and motor power. The sudden appearance of a stranger, or any unusual incident, may thus incite intense fear, and lead to dangerous manifestations, especially if an organic cardiac disorder is present.

In *anxiety states* the cardinal symptom, anxiety, is frequently masked by physical symptoms. Headache, insomnia, fainting spells, heart trouble, dysmenorrhea, asthma, dyspepsia, mucous colitis, etc., are found in anxiety states, the influence of emotion on bodily functions accounting for the association. Pathologic anxiety arises from causes unknown to the patient and may remain floating loose—a fear of nothing in particular—or may attach itself irrationally to any conceivable object. Nervous breakdowns are often exacerbations of an anxiety state, and most cases of “neurasthenia” are examples of pathologic anxiety. M. Culpin (*Lancet*, Sept. 27, 1924).

Pain along the spine accompanied by localized spinal tenderness is often complained of. The upper cervical region near the occiput, over the vertebra prominens, or again the sacrum and coccyx, are frequent sites of this pain. Lumbago, previously referred to, and various muscular pains suggesting rheumatism are frequent. In cases in which spinal symptoms predominate there is also marked muscular weakness—a symptom to which Charcot attached much importance,—and sometimes disturbances of co-ordination, suggesting tabes. General paresis may also be simulated.

Hyperesthesia of certain regions of the skin (Valleix's points) is sometimes noticed. Formication, evan-

escent sensations of localized heat and cold are occasionally complained of, though these sensations may be general, as are also the profuse sweating and the flushes of heat so frequently seen at the menopause.

The writer encountered several cases of an unusual form of neurasthenia coming on abruptly without previous exhaustion. He ascribes the condition to circulatory disturbance in the basal nuclei in the vicinity of the 3d ventricle, since, in addition to anxiety, sensations of flushes in the head, headache, paresthesias, and sexual impairment were especially marked. Heveroch (*Casop. lek. cesk.*, May 2, 1925).

Vertigo is often complained of; in some cases it is almost continuous and characterized by exacerbations, during which the patient may fall and suffer injury. Hysterical manifestations are frequent, especially in women, though true hysteria be absent.

The sensation complained of by some neurasthenics, as if the ground were rocking under them when they walk, is due partly to the fact that the height of the head changes in walking. This causes an increased irritability of the otolithic apparatus, which registers perceptions suppressed under normal conditions. Gatscher (*Wien. klin. Woch.*, Sept. 4, 1924).

Irregular action of the heart, palpitation, is usually noted, the pulse sometimes being very rapid—90 under ordinary circumstances, and from 120 to 160 during attacks of “palpitation;” apprehension, pain, and general distress in the cardiac region often result, increased by the least excitement, anxiety, or fit of temper. The precordial pain may be so severe as to resemble angina pectoris.

Neurasthenic pains are generally improved by movement, contrary to the pain in true rheumatism and

arthritis. This applies also but less constantly to neurasthenic palpitations and pseudoangina pectoris. The patient generally jumps up and walks to and fro, during which the pain subsides. It is often accompanied by general restlessness, palpitations and sweating. Neurasthenics are generally extremely sensitive to heat and to constriction from tight collars. Kollarits (*Deut. med. Woch.*, April 21, 1910).

Throbbing of the arteries, including the aorta, carotids, peripheral arterioles, and even at times the capillaries of the nails, may be witnessed, the veins, at times, taking part in the manifestation. Still the extremities may be quite cold, the patient requiring heavy clothing to feel at all comfortable. This is due to weakness of the circulation, with reactive exacerbations that have been termed "vasomotor storms."

There is practically always in true neurasthenia a long prodromal period, the pre-neurasthenic state, characterized by well defined morbid manifestations indicative of aberrant functioning of the emotional centers.

The immediate cause of this instability is the reaction of environment on the patient's mind. This state is not actual neurasthenia, and may not develop into it, but neurasthenia is its culminating development. Neurasthenia is a definite syndrome which must not be confounded with the nervous asthenia of many neurasthenoid states that constitute the prodromal periods of various psychoses, result from the abuse of stimulants, drugs, or tobacco, or are symptomatic of organic diseases. Neurasthenia should be clearly differentiated from obsessions, hysteria, melancholia and hypochondriasis. The heart and the blood vessels are usually the first to reflect the central functional disturbance in neurasthenia. S. H. Bennett (*Practitioner*, February, 1918).

Visual disturbances are common, the symptoms suggesting astigmatism following any prolonged use of the eyes, which also causes headache and vague distress. The pupils sometimes appear unusually large and often unequal, while the accommodation seems defective. Unilateral ptosis is often observed. The eyes feel weary and heavy, and letters become blurred; flashes and pain are experienced in most cases after reading even a very short time—a few minutes. Examination of the eye reveals a marked readiness on the part of the accommodative apparatus and of the retina to become fatigued, slight rest affording considerable relief. Photophobia is sometimes sufficiently marked to keep the patient in a dark room.

As a rule the urine is scant and high colored, but this is often due to the fact that the patient, as is frequently the case with neurasthenics, drinks but little water. The urine is occasionally increased in quantity, owing to irritation of the kidneys through deficiency of water; this may also cause vesical irritation sufficient in some instances to suggest cystitis. All the fluid secretions, saliva, perspiration, and also the gastric intestinal secretions may be scanty. "Lithemic neurasthenia" is a term applied to a form in which, besides the other symptoms enumerated, manifestations of lithemia are marked. Phosphaturia, oxaluria, and glycosuria are frequently (14.4 per cent., according to Arndt) noted.

Sexual impotence is more or less marked and in some cases is total. Seminal emissions at night and during defecation and micturition may be frequent, and depression after

coitus is usually complained of. Masturbation as a feature of the past history of the patient is given by him an exaggerated importance as a cause of his neurasthenia. Or, he may lay stress on pollutions, premature ejaculation, or absence of or unsatisfactory orgasm. The testicles or ovaries may be extremely sensitive to pressure, a dull, heavy pain, quite persistent at times, being occasionally experienced. Pain in the inguinal region may be noted. In women, nocturnal orgasms, followed by depression or exhaustion, may be complained of. Pelvic pain may occur.

Sexual neurasthenia is often ascribed to definite pathological conditions in the genito-urinary tract, especially in the vicinity of the verumontanum. According to Orłowski, however, the verumontanum is not responsible for the disorder.

There are six types commonly called neurasthenic: (1) Neurosis or anxiety neurosis; (2) mild, rare or atypical psychosis, *e.g.*, manic-depressive psychosis and dementia precox; (3) incipient tuberculosis; (4) low grade cryptic infection; (5) early exophthalmic goiter; (6) cerebral arteriosclerosis. Neurasthenia should be considered as an abnormal, imperfect, inadequate type of reaction, expression or auto-erotic fixation; an infantile type of reaction in which the individual takes an undue interest in his own body, of which he is acutely and abnormally conscious. On these sensations he often erects a more or less organized system of false ideas (auto-erotic inversion). W. J. Mallory (Jour. Amer. Med. Assoc., Mar. 19, 1921).

Frequently aroused but incompletely gratified sexual desires are a cause of neuroses. There is an anxiety type of neurosis in which vagotonic symptoms such as globus, pylorospasm, spastic colon, palpitation and sweating,

general uneasiness and, as time goes on, a vague fearfulness, can all be the result of either coitus interruptus or, in unmarried people, of frequent social contacts without complete physical relations. Such symptoms are apt to become chronic and last even after removal of the cause, if the latter has been operating frequently. Wright (Med. Jour. and Rec., Sept. 1, 1926).

Indigestion of the type called "nervous" is a common feature of neurasthenia. The digestion is enfeebled and delayed and is associated with atonic constipation, and gastralgia is sometimes complained of. The appetite is capricious, and distaste for food may prevail. Hyperchlorhydria is sometimes observed, but as a rule the patient complains of loud, gaseous eructations, and delay in digesting his food, the latter "lying heavy" in the stomach. The gaseous distention may cause "palpitations" and epigastric and precordial distress. Gastropnoia is not infrequent.

Neurasthenic gastric neuroses are distinguished from hysteric neuroses, not by the somatic symptomatology, but by the total psychic content. Thus, there may be observed in a working person anxiety over the impaired functioning of his exhausted nervous system. Perception of the marked fatigability leads to exaggerated self-observation and fear of disease. In severe cases, a special effort should be made to improve the patient's general condition. E. Leyser (Klin. Woch., June 16, 1924).

In severe cases, the gastric disorder is more severe. The eructations of gas become distressing, more frequent, and sufficiently forceful to be noisy. Meteorism, alternating constipation and diarrhea, colicky pains, due to defective intestinal digestion and the resulting fermentation, are prominent features of this stage. In such cases autointoxication is an important feature.

In diagnosticating neurasthenia the bacteriologist's colonic findings should be taken as starting point. The toxins produced by many colonic microbes, bacterial or protozoan, are definitely known to be injurious to the cells of organs, and those influencing the ductless glands abnormally are largely derived from bacteria of the colon. The surgeon can help in many cases by fixing the loose kidney, suspending the sagging colon, and separating adhesions that interfere with gastric or intestinal motility. R. T. Morris (Arch. of Diag., Jan., 1913).

Tinnitus aurium, hyperacousis (the patient starting at the slightest sound), and loss of taste also occasionally accompany the more prominent symptoms. The patient may complain of unpleasant odors or tastes. Undue redness of the ears and conjunctiva is frequently observed. Heaviness and throbbing about the scalp, or a feeling as if cold air or water were circulating under it, are occasionally complained of.

DIAGNOSIS.—Various *neuroses* and *psychoses* may readily be taken for neurasthenia when the symptoms of the latter are few and indefinite; but this is rare, and the characteristic fatigue supplemented by the main symptoms that typify the affection usually render a diagnosis easy.

The scope of neurasthenia should be limited to "nerve fatigue." Among the many conditions mistaken for it are neuroses, chronic infections and intoxications, incipient true physical disease, incipient psychosis, endocrin conditions, and neurosyphilis. Laboratory tests are essential to the diagnosis. The urine may reveal intoxications or nephritis; the blood, infections, syphilis, blood sugar changes, etc.; the spinal fluid, neurosyphilis. Boehme (Med. Rec., Jan. 28, 1922).

In anxiety states, general complaints of loss of memory, inability to concen-

trate, depression, or nervousness should be met by a request for examples. "What sort of thing makes you nervous?" will often bring out unsuspected fears and inhibitions, though it may be necessary to ask specifically about such trouble as fear of subway trains, of being in the dark, or of sitting alone in a restaurant. Obsessional symptoms, *e.g.*, returning several times to make sure that a door is fastened, are themselves productive of anxiety and indicate a condition more deep-seated than the pure anxiety state. M. Culpin (Lancet, Sept. 27, 1924).

Hysteria may be confounded with neurasthenia, and both affections may exist simultaneously in some cases. The absence of crises and contractures, among other hysterical stigmata, serves to eliminate the disease as the primary one. In hysteria the onset is often sudden, there are manifestations of superabundant nervous energy rather than the opposite, and insomnia is not a pronounced feature. It must be remembered, however, that hysteria is so commonly associated with neurasthenia that a special name, "hysterical neurasthenia," has been proposed for cases showing the combined syndromes. Such cases lack, however, typical manifestations of hysteria, *viz.*, anesthesias, palsies, convulsions, and complete loss of self-control.

Tabes Dorsalis.—In neurasthenia reflex action is generally increased, while in the majority of organic affections of the system, including tabes, it is diminished.

General Paresis.—In this disease there is reduction of mental activity, while in neurasthenia the intellect is not necessarily impaired and is overactive in many cases. Mental labor is practically impossible, owing to the subsequent untoward effects.

When a history of syphilis is present, however, symptoms of general paresis may supervene in addition to those typifying neurasthenia. This is particularly to be suspected when articulation is impaired, or when the formation of sentences in writing becomes unusually difficult.

The early stage of any chronic psychosis may exhibit symptoms of a neurasthenic, simple depressive, or anxiety neurosis type. In early *dementia paralytica* a mild depression combined with anxious, restless feelings, without any delusions or extravagant behavior, and with some absent-mindedness, attention disorder, and lowering of the esthetic and moral sense may be the only symptoms for a long time. Not unusually, however, the speech is somewhat affected, especially if definite test phrases are given and slight slurring and tremor listened for in the replies.

In early *manic-depressive psychosis*, in addition to the fatigue syndrome, questioning will bring out anhedonia or general distaste for all customary interests, a feeling that nothing is worth while, and an indifference toward relatives; such a mood may alternate with a short period of mild overactivity and brief elation or euphoria, sleep being less than normal.

In the *hebephrenic type of dementia precox*, an early diagnosis from neurasthenia is sometimes impossible. Before long, however, there occurs a change in the patient's appreciation of his responsibility toward others and an inability to master ordinary difficulties. In both the sane neurasthenic and the hebephrenic there are cold, clammy, and cyanosed extremities, exaggerated reflexes, the visceroptotic habitus, and other signs of constitutional inferiority. A careful history of the whole course of the disorder may, however, be helpful; the ordinary neurasthenic may have always been more or less asthenic, while the early precox case has had average health and efficiency until recently. H. W.

Wright (Med. Jour. and Rec., Sept. 1, 1926).

Exophthalmic goiter may also be confounded with neurasthenia. When there is no exophthalmos, the enlargement of the thyroid becomes—aside from the basal metabolism,—the only reliable distinguishing feature, the rapid pulse, agitation, tremor, etc., being all present in neurasthenia.

As regards the differentiation of neurasthenia from hyperthyroidism and heart disease, symptoms common to all 3 are breathlessness, tachycardia, heart pain, and vasomotor disturbances. Features peculiar to hyperthyroidism are goiter, staring, high basal metabolism, and female preponderance. Basal metabolism should not be overvalued as evidence, and the need of repeated tests realized. To diagnose heart disease usually requires at least one of the following: Enlargement, diastolic murmurs, primary disorder of the heart beat, signs or history of heart failure. Rheumatic or syphilitic history gives added weight to doubtful signs. In borderline cases, accurate diagnosis requires prolonged or repeated observation. Hamilton and Lahey (Jour. Amer. Med. Assoc., June 10, 1922).

Hypochondria.—This disease being a form of melancholia, with illusions concerning the health, it is not under the control of the patient, whereas the neurasthenic is sufficiently master of himself to yield, if made clearly to understand, to an explanation of the source of his imaginary ills.

Lymphocytosis and eosinophilia were noted by the writer in a number of neurasthenics. Hofferbert (Berl. klin. Woch., Nov. 7, 1921).

ETIOLOGY.—Heredity acts only as a predisposing influence through parental neuroses or psychoses. Syphilis, tuberculosis, rheumatism and gout may also act as predisposing conditions in the offspring. Excesses

of all kinds, particularly in sexual relations, lower the resistance of the organism as a living entity (not only of the nervous system), and pathogenic factors find a fruitful field which, had not inherited depravity prevailed, would have proved sterile.

Individuals so predisposed represent by far the majority of cases witnessed. There is another class, however, in which the ever-increasing responsibilities attending modern methods of living, unrestrained extravagance, desire to promptly acquire wealth, and the worriment attending the responsibilities incurred, undermine metabolic dynamism, thus initiating the disease. If the victim of worriment can so change his occupation and his mode of living before the inroad of the malady is marked, a prompt return to health usually results.

In both classes the exciting conditions are similar; and sexual indiscretion, continued worry and overwork, shock accompanying injury, exposure, indiscretions in diet, improperly selected or insufficient food, and many diseases, particularly influenza, syphilis, typhoid fever, and such disorders as alcoholism, morphinism, cocaineomania, etc., tropical climates in which humidity is added to heat, will act as primary causative factors of the typical form.

Tropical neurasthenia is extremely common among Americans who go to the Philippines, men and women suffering with it after they have resided there a year or more. Women suffer almost invariably with uterine disease in connection with the neurasthenia; vasomotor disturbances of various kinds are also common. Tropical neurasthenia responds to treatment more readily than the ordinary kind, change of climate

being especially beneficial. Fales (*Amer. Jour. Med. Sci.*, April, 1907).

In a study of postoperative and postanesthetic neurasthenias and psychoses, the total of patients examined was 344: women, 220 (or 64 per cent.); men, 124 (or 36 per cent.). Instances of neurasthenic or mental disorders following operation, or æsthesia, 31 (or 9 per cent. of the total patients examined); women, 29 (or 94 per cent. of the postoperative cases); men, 2 (or 6 per cent. of the postoperative cases). The operations in these cases varied widely, from the most trifling surgical intervention, such as ocular tenotomy, straightening of the nasal septum or dilatation of the cervix uteri, up to total hysterectomy and ovariectomy. The worst and most persistent examples of nervous disorder not by any means always followed the most serious operations. No doubt a certain constitutional or temperamental predisposition is required as a precedent, and one cannot make a rule excluding this as one of the causes, as one would in judging of purely traumatic neuroses. J. K. Mitchell (*Amer. Jour. Med. Sci.*, July, 1911).

Neurasthenic symptom-complex observed in patients suffering from lead poisoning, more marked in the ambulatory forms of the disease. This manifestation of plumbism is one of the most common and is to be considered as a psychic form of lead dyscrasia. Samson Hirsch (*Deut. med. Woch.*, Feb. 12, 1914).

In women, excessive fecundity, dysmenorrhea, and the menopause are thought to exercise a marked exciting influence. According to Peterson, the pelvic organs themselves play but a small rôle in these physiological commotions. They have to do with the whole organism of woman. Pelvic diseases in woman attended by exhausting pain may give rise to neurasthenic and hysterical states, but the influence of ex-

hausting pain in these organs is no greater than similar exhausting pain elsewhere in the body. Disorders of the female organs which affect the nutrition of the nervous system, such as excessive hemorrhage or suppurative processes, may also be important factors in inducing functional neuroses, though disordered blood-states brought about by pelvic disease are very infrequent as compared with disordered blood-states dependent upon disease elsewhere.

Of all causes those connected with the male sexual organs have been credited with the most active etiological rôle, especially focal infective disorders, such as prostatitis, posterior urethritis, seminal vesiculitis, etc., and general disorders and habits, such as gonorrhea, syphilis, and masturbation.

Indeed, focal infections in various other locations have been found to induce neurasthenic states.

Case of true neurasthenia which was a manifestation of the toxic action of diffuse tuberculosis. The morbid depression of mind and body was evidently secondary to the infection. A. Tardieu (*Paris méd.*, Apr. 12, 1924).

Attention called to sepsis, usually of the focal, latent, or cryptogenic type, as a frequent essential cause of functional nervous disturbances, ranging from slight blunting of intellectual activity, through the more definite forms of abnormal taciturnity, inability to concentrate, unsociability, and the varying syndrome of psychic abnormality grouped under the terms neurasthenia and hypochondriasis, to the graver mental manifestations with suicidal impulse, delusional insanity, mania, and ultimately dementia precox. E. Watson-Williams (*Brit. Med. Jour.*, July 4, 1925).

As to the influence of sex upon the genesis of the disease, an analysis

of 333 cases by Joseph Collins and Carlin showed that 55 per cent. were males and 45 per cent. females. Statistics by Cleghorn, based on 6000 cases, showed the disease to be far more prevalent in men than in women. Hebrews and Slavs seemed to be particularly predisposed to neurasthenia, but this view is probably to be ascribed to the fact that New York, in which these analytical studies were carried on, contains a very large proportion of individuals of these races who, because of poverty, apply to dispensaries for treatment.

Occupations which impose the necessity of remaining indoors, especially where considerable intellectual work is done, furnish a large proportion of cases. Lack of self-control in emotional individuals—musicians, for example—or frequent fits of anger, and overtraining in colleges and other institutions of learning, predispose to and may even initiate the disease.

Breakdown may show itself in some condition of the eye, throat, or chest, as well as in general debility. The school child may have no focal infection, yet fail to react properly to stress, owing to excessive strain, malnourishment, insufficient rest, or friction between the father and mother. A young girl, ill for some time, with a progressive longing for rest, had asthenia due to endocrin hypoplasia, but was overambitious and desirous of "making something of herself." She had been told there was nothing the matter with her, and to get out and ride horseback, play tennis, etc. Overstress resulted; superficially she is well, and able to work; but if she goes beyond her strength she becomes debilitated at once. T. A. Williams (*Atlantic Med. Jour.*, July, 1925).

Among the causative factors noted in Cleghorn's series of cases, disturbances of the gastrointestinal tract

and the intoxications stood out as the principal ones, and the symptoms most constantly present seemed to be headache, insomnia, and constipation.

The soil for neurasthenia is sluggish metabolism. The onset is gradual, generally after some disease, physical overexertion or worry, with hypotonia of the muscles and insufficiency of the endocrin system, circulation, digestion, etc., and a tendency to visceroptosis. M. de Fleury (*Presse méd.*, July 4, 1923).

That the ductless glands play an important rôle in the genesis of neurasthenia is probable. If, as I have urged, the thyroid and adrenals (see *ANIMAL EXTRACTS*, Vol. I) assume an important part in oxidation and in protecting the body against autointoxication, any condition which exhausts these organs must necessarily impair the general dynamism and lower the vascular tension, the underlying causes of neurasthenia in most cases.

Cases classified formerly as neurasthenics are due to disorders of the internal secretions. The depression of hypothyroidism, more particularly in older people, is notable. In dysthyroidism there are peculiar recurrent states of neurasthenia, great prostration, and inability to concentrate; pituitary disorders, too, create neurastheniform symptoms. Insufficiency of the adrenals may also produce neurasthenia characterized by extreme asthenia, inability to think clearly, and discouragement, as a rule with low blood-pressure. T. A. Williams (*Med. Press*, Jan. 19, 1916).

Following etiologic conditions observed in so-called neurasthenic states: Agoraphobia related to depletion of glandular secretion; low blood-pressure or lack of adrenal output; hyperproteosis with raised blood-pressure; faulty posture at the keyboard in a stenographer with gnawing pain in the

neck and shoulders; migraine; severe pain in back and lower limbs due to radiculitis from an old infection; brain tumor; phobia in an actor unable to perform or remember his lines, induced by an unfavorable criticism; similar condition in another actor, induced by jealousy; focal infection; latent tuberculosis; perhaps hypovitaminosis, mild cardiopathies, and dyspituitarism. T. A. Williams (*Amer. Med.*, 1922).

The small proportion of cases in which heredity plays an active rôle usually appears during the transition between childhood and adolescence—15 to 20 years,—while those in which the acquired form obtains occur during the most active period of life, *i.e.*, between 20 and 50 years. It is essentially a disease of the period of life during which great exertion and anxiety combine to increase the wear and tear of the central nervous system, and indirectly of the organism at large.

PATHOLOGY.—Neurasthenia was for a long time attributed solely to exhaustion of the nerve-centers presiding over general nutrition, and particularly of the brain and nervous system. Actual loss of substance in the cells, and especially in the nucleus, has been noted by Hodge. Impaired metabolism, with accumulation of waste-products, which in turn circulate in the blood, gives rise to an autointoxication affecting especially the nervous system, and the functions over which the various systems preside are correspondingly impaired. This is further encouraged by the continued waste of energy from which the patient suffers if he persists in imposing even slight tasks upon his weakened organism. A vicious circle of pathogenic activity is thus formed.

In all cases examined von Bechterew found that there were a considerable diminution in urea and an increase in the uric acid. The relation of the total nitrogen to the quantity of urea indicates a marked decrease in the intensity of nitrogenous oxidation. The ratio of the uric acid and disodium phosphate indicates an increased production of uric acid. In many cases the condition of the patient improves coincidently with diminution or disappearance of the arthritic phenomena. The urinary changes point to intestinal putrefaction.

Analysis of the blood in thirty-three cases of neurasthenia by Roemeister and Collins revealed that many cases show a decreased ratio of leucocytes to erythrocytes. Nearly all had a more or less marked oligochromemia, often with many microcytes and a few poikilocytes.

PROGNOSIS.—Left to itself neurasthenia tends to persist, unless its cause, especially worry, excessive work, mental or physical, a debilitating habit, etc., be removed. There may occur periods of improvement, but relapses occur readily.

Under proper prophylactic measures and judicious treatment, however, the prognosis is usually favorable. Especially is this the case if the organic changes outlined have not had time so to undermine the functions of the organs secondarily involved—especially the stomach and kidneys—as to compromise their physiological functions in nutrition and elimination of waste-products.

The occurrence of symptoms recalling locomotor ataxia or general paresis and impairment of articulation, though alarming, does not necessarily indicate a dangerous condition. Indeed, unless

of too prolonged standing, they are sometimes the first to yield to appropriate measures.

TREATMENT.—**Rest, mental and physical, distractions, nutritious—though easily digested—food, and removal of baneful influences** as far as possible, constitute the predominant features of treatment. Physical and mental rest, however, does not mean the total cessation of activity, but a **reduction of the work** imposed upon the organism as a whole, preserving for it sufficient dynamic stimulation to activate all vital processes. The slight increase in the action of the heart derived from a short walk, for instance, increases the efficiency of assimilation, and, as life is but the transformed energy of the food ingested, the primary factor of repair is thus assisted. Yet, undue exercise would, by inducing fatigue, bring about a contrary effect. Metabolism being deprived of a sum of energy corresponding to the excess of exertion imposed upon the organism, its activity would be reduced in proportion and all the symptoms exaggerated.

The writer emphasizes the importance of recognizing that proper treatment of neurasthenia can only be based upon the detection of one of the many causes which underlie the disease in a given case. In the one, excessive intellectual labor and emotional stress will have caused failure of his endocrins. The latter, compensated by judicious organotherapy, will soon recover and cause the neurasthenia to disappear. Genetic factors, hyperproteosis with raised blood-pressure, radiculitis of arthropathic origin, faulty occupational position causing pain, overnourishment to counteract a supposed breakdown, a cortical neoplasm, a phobia due to mental stress, jealousy, vagotonia, are illustrated by specific cases

as among the various etiological factors which must be specifically met. Williams (Med. Rec., Apr. 23, 1921).

The just merits of each individual case should be taken as guide in treatment. In some cases the disease is due to ocular defects. The **correction of eye-strain**, if any exists, is beneficial even if the disease be due to other causes. In all the milder cases of neurasthenia, removal of the main etiologic factors is likely to result in recovery through the operation of the patient's natural recuperative powers. If mental overwork has led to the condition, **rest of the brain**, with freedom from anxiety, will be very helpful.

The writer describes as "high grade neurasthenics" individuals relatively normal mentally and physically who are tired, inefficient, irritable, sleepless, depressed, etc. If no organic disease can be found, the rules of **physical and mental hygiene** should be consistently applied. In many neurasthenic sufferers from flat-foot, sacro-iliac strain, and backache, a general **physical setting up** helps greatly, relieving fatigue. **Forced feeding, short walks, frequent rest periods, and occupational therapy** are other useful measures. H. J. Hall (Boston Med. and Surg. Jour., Aug. 25, 1921).

The benefits of **rest** in the average case may be secured by spending four to six additional hours in bed, by retiring early and getting up late. Or, a couple of hours' rest during the day may replace the morning hours of rest, if these are inconvenient. An outline of the course which Weir Mitchell adopted in severe cases will illustrate the general principles of treatment:—

"On awaking in the morning the patient is to take a cup of cocoa, after which she is to rest for twenty minutes. She is then to get out of bed and sponge herself with cool water or be sponged by an attendant, after

which she is to be rubbed dry with a coarse towel. She is then to dress leisurely, and lie down for twenty minutes before breakfast; after which meal she is to lie down again for an hour, and rest absolutely. Massage [gentle] should be given at 10 or 11 in the morning, and this be followed by an hour of rest. She then takes a cup of strong soup or, preferably, milk. The patient may then go about and attend to any duties until luncheon; and after this meal rest is also to be taken. During the afternoon the patient may walk or drive and attend to business matters; but she should not exercise more than she can possibly help. If electricity be used, it is best given just before the evening meal or at bedtime. The patient should retire early."

Men do not respond to the Mitchell rest cure (see **REST CURE**, this volume) unless virtually bedridden.

The actual nature of the **massage** movement performed in neurasthenia is of minor importance, according to Mennell, provided that it is rhythmical. Only the most gentle movements possible are to be performed; irritating, so-called stimulating movements are contraindicated. Any point that is tender or hypersensitive is the last that should receive attention.

Stress laid on **massage**, which is generally followed by aptitude for proper rest or work. Deep massage without friction proved much the best. **Graded exercises** at regular times are valuable accessories. D. Graham (Med. Rec., Apr. 15, 1922).

Each phase of the non-pharmaceutic treatment must be regulated to suit the patient's means and strength. **Traveling** is almost always useful, unless too arduous; the **changes of scene** greatly tend to alter the morbid trend of the mind. An altitude over 2000 feet is, however, too stimulating. The **sea-coast in a wooded country**, where fogs are infrequent, is usually very beneficial, especially if preceded by a **sea-voyage**.

Isolation is recommended by many writers when neurasthenia is accom-

panied by very marked symptoms of lowered nutrition and muscular weakness, and when a prolonged rest in bed is insufficient to arrest the emaciation. Other therapeutic factors are **generous feeding**, with selection of dishes relished by the patient, and **rest in bed**, the latter being necessary during the first six weeks of the complete treatment. **Overfeeding** is sometimes obligatory. It consists especially in the progressive administration, each day, of 3, 4, 5, and 6 pints of milk in divided amounts. After a few weeks, one or two eggs a day may be added. Or, overfeeding may be carried out by the addition of milk and eggs between meals to an ordinary mixed diet.

An examination of the gastric functions should preferably be made, and the diet adjusted according to the conditions of acidity found, with administration of dilute **hydrochloric acid** before meals where hypo- or anacidity is found.

An inquiry into the presence of **foci of infection**, followed by their **removal** if found, is indicated.

Where the disorder is due to sexual excesses, rest of the function is essential. Local treatment, especially of the verumontanum, has been widely advocated, but some believe that such treatment acts only by suggestion.

Five cases of impotency or sexual neurasthenia seemingly cured by **local treatment** of the inflamed or otherwise abnormal **verumontanum**. A. Valerio (Brazil-méd., Aug. 16, 1924).

An ever-recurring trouble is remorse at masturbation. The physician, by recognizing that the dreadful effects ascribed to it are imaginary, will find less difficulty in dealing with this remorse. Even so he may fail, however, and observe that he is dealing with an emotion arising from some deeper complex and secondarily at-

tached to the masturbation. This displacement of emotion is characteristic of nervous symptoms and is of practical importance in treatment. A simple technique consists in placing the patient on a couch, making him describe and, if possible, feel the emotion concerned—the feeling associated with a specific phobia, for example,—and urging him to remember any occasion in the past on which the same emotion was felt. This method was successful in the war cases, and if the practitioner only once revives a lost memory by it he gains an insight into the mental processes. His influence must be used in supporting the patient and encouraging him to carry on the duties of life. M. Culpin (Lancet, Sept. 27, 1924).

Electricity has been extolled by many. As to the kind of current to be used, no general rule can be laid down. Some assert that **static electricity** stimulates vital function and promotes elimination of poisonous materials. The slowly interrupted **faradic current**, applied to the individual muscles, up to a limit of $\frac{1}{2}$ hour, may be used to compensate for lack of exercise. **Diathermy** has likewise been employed.

Hydrotherapy has also been highly recommended. In cases with severe dyspeptic symptoms Winternitz has obtained excellent results from the following procedure: The patient is placed on his back and covered with a sheet well wrung out of cold water (from the armpits to the knees). Before covering this with a dry sheet, a coil of rubber tubing is applied to the epigastrium, through which a current of warm water at a temperature of 122° F. (50° C.) is passed. This procedure is continued for half an hour before each meal during a number of weeks.

The application of cold over the

spine is credited with marked efficacy by Kinnear, the bags being applied from the fourth to the last lumbar vertebra. A cold sponge along the spine when rising acts as a stimulant.

Insomnia sometimes requires active measures, but morphine, stimulants, and all agents capable of starting a "habit" should be strictly prohibited. The bromides are also pernicious in these cases, since they tend to retard metabolism. Trional and other hypnotics have been recommended for the purpose, but the **hot pack** is far preferable..

Sleep is also favored by taking a **warm bath** of ten minutes' duration, followed by a glass of **hot milk** just before retiring.

Codeine has been praised. Its good effects cannot be due to its narcotic properties, considering the small dosage. In $\frac{1}{6}$ -grain (0.01 Gm.) doses, given thrice daily for four to five days, and later the same amount five or six times daily, it produces satisfactory effects. The dose can be decreased as soon as the patient improves.

Among the general remedies, **strychnine** still holds the first place. Beginning with $\frac{1}{60}$ grain (0.001 Gm.) three times a day, the dose should gradually be increased until the physiological effects of the remedy appear. The dose should then be slightly reduced, and the weaker dose continued persistently until recovery becomes assured.

Strychnine is almost a specific in neurasthenia. The writer gives it in increasing doses—always in excess of 6 mg. ($\frac{1}{10}$ grain) daily dose. By reason of the fact that strychnine is not retained in the body certain individuals can acquire a tolerance of several centigrams a day. In anxious

states this high dosage is not indicated and by the mouth $\frac{1}{10}$ grain daily dose need not be exceeded, while $\frac{1}{15}$ suffices by the hypodermic route. To give larger doses would very likely increase the severity of the anxious state. Hartenberg (Med. Record, Aug. 31, 1918).

Arsenic, iron, and other tonics are often valuable. Glandular products, including **thyroid gland**, 1 grain of some American preparation, such as Armour's, which equals 5 grains (0.3 Gm.) of the fresh gland to the grain (0.06 Gm.), or **pituitary** (whole), 2 grains (0.13 Gm.) three times daily, are very efficient. **Corpus luteum** in large doses is often effective in women.

When the patient complains of chilly sensations, cold hands and feet, lack of perspiration, irregular muscular pains, and physical inertia, without signs of heart weakness, ordinary treatment is greatly aided by small amounts of **thyroid substance**, 1 grain (0.06 Gm.) two or three times daily. Improvement in ten days; stop drug for a week, then resume, etc. 2. When there is constant restlessness, with sense of heat, bright eyes, shiny and moist skin, glossy hair, tremor, exaggerated knee-jerks, abnormal hunger, diarrhea and menstrual flow, and pulse 80 to 90, remedies such as **belladonna, hydrastis, thyroidectin, ergot, and bromides**, and ice applications to thyroid gland for half an hour three or four times daily, are likely to benefit. 3. Where the patient is abnormally fat, with constant gain in weight, lack of ambition, craving for sweets, and headaches, **pituitary** or **thyroid substance** (1 or 2 grains—0.06 to 0.13 Gm.—a day) often does good. M. Allen Starr (Med. Rec., June 29, 1912).

Respiratory exercises are very helpful. Overexertion must be carefully avoided. Exercise should be limited to the use of pulleys or dumbbells.

All disorders, primary or secondary, should be treated, those of the digestive apparatus particularly (see STOMACH, DISEASES OF), but in the majority of cases improvement of the general health causes disappearance of complications. **Laxatives** are important to counteract the autointoxication resulting from constipation. At the start the intestine may be flushed out with **calomel** and a **saline purgative**. Later, **cascara**, **rhubarb**, or **aloin** are suitable; or, **sodium phosphate** in dosage just sufficient for a laxative effect may be taken before breakfast.

Orbison has reported 8 cases of neurasthenia attributed to intestinal troubles and cured by corresponding measures. There was a hereditary taint, neuropathic susceptibility, fear in its various phases, and a constant condition of intestinal putrefaction that had to be overcome before any relief was achieved; in many of the cases this was associated with insufficient elimination of urine.

The need of eliminating factors which upset endocrin equilibrium is referred to by the writer. **Toxic states** must be overcome. To convince the patient that the organism is capable of recuperating is useful, as are also **massage**, **exercise**, and **hydrotherapy**. In most cases, the functional deficiency of the ductless glands requires **organo-therapy**, and some striking cures therewith have been witnessed. Goormaghtigh (Arch. méd. belges, Nov., 1921).

It is important in this class of cases to gain the patient's confidence and to recognize his infirmities rather than persuade him that many of them are imaginary. The endless complaints and fault-findings of neurasthenics are symptomatic. **Psychotherapy** in these cases is usually effective; indeed, according to some, it is the fundamental agency in the treatment. **Sympathy** and considera-

tion gain for the physician the patient's confidence and insure his cooperation in the curative measures instituted.

Of the specific psychogenetic symptoms which stand out as guide posts after physical examination has excluded reasonable physical causes, fear is significant. It may be just vague fear of nothing, or of some particular thing, *e.g.*, of going out on the street or of riding in elevators, ferry-boats, or trains. In either instance fear is most often simply a symbol of indecision about something of import to the patient's immediate future or present situation. The fear of being alone is often due to the fact that when alone the matter that the patient is undecided about keeps recurring to mind. That of going out or getting on an elevator, boat, or train may be due to some previous fearful experience. Vague general fear is often due to indecision as to making some definite change in life, *e.g.*, of employment and location. After weighing matters pro and con for days or weeks, such a patient becomes fatigued, sleeps poorly, loses appetite and digestive powers, has feelings of pressure in the head, and even an increase of blood-pressure, accounted for by the excessive action of the vagus and sympathetic nerves and the endocrin glands produced by disturbing and fearful emotions. In such cases the physician or someone else may have to do the deciding for the patient. There may have been indecision of character to begin with, but it is only indecision about matters of real importance that produces serious symptoms. As soon as a decision is made and acted on, all the symptoms disappear. H. W. Wright (Med. Jour. and Rec., Sept. 1, 1926).

CHARLES E. DE M. SAJOUS,
Philadelphia.

NEURITIS. See NERVES, PERIPHERAL, DISEASES OF.

NEURITIS, OPTIC. See OPTIC NERVE AND RETINA, DISEASES OF.

NEURONAL.—Neuronal (brom-diethylacetamide; diethylbromacetamide) is a bromine compound of diethylacetamide [$\text{Br}(\text{C}_2\text{H}_5)_2\text{CO}.\text{NH}_2$]. It occurs as a white, crystalline powder, having a camphoraceous odor and a bitter, cooling taste, freely soluble in alcohol, ether, and oils, and in about 115 parts of water. Dose, $7\frac{1}{2}$ to 30 grains (0.5 to 2 Gm.).

PHYSIOLOGICAL ACTION.—According to Liebert, Becker, and others, neuronal produces quiet slumber about thirty minutes after its administration, with no unpleasant after-effects. It is asserted that the drug has no cumulative action. Stroux ranks it in efficiency and dose with trional, barbital, and chloral hydrate, but considers it preferable to these drugs because of its lower toxicity. The sleep induced is quiet and natural and the patient awakes refreshed and without headache. Stroux found that less than 15 grains (1 Gm.) does not act in the majority of cases; 45 grains (3 Gm.) were well tolerated; the highest daily dose employed by him was 53 grains (3.5 Gm.), which did not produce any ill effects.

THERAPEUTICS.—This drug is used as an hypnotic and in cases of excitement of the nervous system. Restlessness associated with cardiac disease, arteriosclerosis, and hemiplegia was observed to be favorably influenced, and even tabes, neuralgia, and other conditions accompanied by severe pain were benefited (Bleibtrau).

Since neuronal contains 41 per cent. of bromine, Stroux tried it in a number of cases of epilepsy. It lessened the number of fits and improved the psychic condition of the patient, though in 1 case it had to be discontinued on account of extremely severe headache.

Its use has been suggested by Bleibtrau in pertussis, on account of its bromine content. In senile dementia, catatonia, and maniacal insanity its action is not satisfactory. W.

NEWBORN, DISORDERS PECULIAR TO.—The newborn period varies with the individual child. The characteristics of the newborn infant may change in 2 or 3 weeks, or may

even persist until the infant is a month old. Since the first month of life exacts the greatest toll of deaths, it must be accepted as the most dangerous period. Approximately $\frac{1}{10}$ of all babies born die in the first 4 weeks of their existence. According to the Federal Children's Bureau, there were, in 1921, in the Birth Registration Area, 68,021 deaths of infants during the first month of life; in the entire United States during the same year there were, according to estimate, more than 100,000 such deaths. Of the infant mortality in the first year of life 44.5 per cent. occurred during the first 2 weeks, and only 8 per cent. during the third and fourth weeks.

This heavy mortality of the newborn is attributable to 2 conditions: (1) That the newly born are immediately subjected to influences which are inimical to health, and (2) that the diseases of the newly born are just beginning to be better understood and more scientifically treated.

In spite of aseptic methods in the parturient period, the mortality and morbidity of newborn infants' lives have been only slightly lowered. Malformations, birth injuries, and various forms of asphyxia are responsible for the deaths in the first few days, while to the infections must be attributed the great majority of deaths after the first week. This appalling death rate will be lowered when this period of relative immaturity is more closely studied, when obstetric operations are made by those who are especially competent, and when asepsis will be more rigidly carried out during at least the first two weeks of life.

[Schwarz states that taking care of the health of prospective mothers and preparing them physically and mentally for

their task of nursing and raising their offspring are the first and the most important steps in the conservation of infant life. At present only a small percentage of expectant mothers receive proper attention during gestation, and every year thousands of mothers and babies die or are permanently injured whose lives and whose health could have been preserved by reasonable prenatal care.

By attention to hygiene, eclampsia is often avoided; at other times the early recognition of the pre-eclamptic stage, as expressed by change in the urine, increased blood-pressure, headaches, disturbed vision, and edematous swellings, may enable the physician to prevent the outbreak of the convulsions. Pelvimetry, exact obstetrical diagnosis, arranging for delivery in safe surroundings, and providing for competent nursing, are important in prenatal care.

Inadequate obstetrical training and insufficient control by State boards of health of the persons engaged in obstetrical practice, and the ignorance of the general public regarding the means by which childbearing can be made safe and comfortable, are largely responsible for the present deplorable state of affairs.

The factors at work to bring about a betterment of conditions are improvement in obstetrical teaching; establishment and extension of obstetrical dispensaries; attempts to impart much-needed information to expectant mothers through the missionary educational work of prenatal nurses, and through the publications of the United States Children's Bureau.]

PHYSIOLOGICAL PECULIARITIES OF THE NEWBORN.—The disorders of the newly born will be better understood if one keeps in mind the physiological peculiarities of this period which make the infant so susceptible to attacks of disease. That there is an undeveloped heat-regulating apparatus, especially in the immature, should be kept in mind. Both sudden cooling or undue high temperature will produce deleterious effects.

The change to pulmonary from placental respiration, if not normally accomplished, leads to lung collapse, or asphyxia. The respirations are normally rapid, 30 to 50, at birth, and irregular in frequency and force. The pulse rate differs little from that of the fetus, approximately 130. Over the heart it is not uncommon to note a systolic murmur in the early weeks of life. The rectal temperature of the newborn during the first day of life is frequently 100° F.

The blood-picture shows a red cell count of between 5 and 7 million, and the hemoglobin is also high, reading between 100 and 120, and declining to 100 by the third day. At birth the white cell count is usually from 15,000 to 20,000. At first, there is a majority of polymorphonuclear cells, but in the second week, the lymphocyte count steadily increases until it reaches 70 per cent.

From a study of the blood of 32 normal infants the writer concluded that the blood of the newborn is abnormally rich in cells and in hemoglobin. Nucleated red cells are found in the first few days of life. The red cells range from 5 to 6½ million; the leukocytes from 9000 to 20,000, and the hemoglobin, from 98 to 135 per cent. The neutrophils declined from 66 per cent. on the first day of life to 57 per cent. on the sixth day, while the lymphocytes increased from 25 to 40 per cent. The bone marrow at birth contains more premature red than white cells; in the succeeding days, however, the converse becomes true. The increase in the white cells in the marrow coincides with the decrease of the polymorphonuclears in the blood. There appears to be an inverse ratio between the number of cells in the blood and the premature cells in the bone marrow. This does not apply, however, to the eosinophiles, which

occur in proportionate numbers in both the blood and marrow. R. Pollitzer (*Pediatrics*, Oct. 1, 1924).

The urine, which at first is seen to be clear, becomes cloudy and often remains so for several days. Evidences of what were formerly interpreted as pathological kidney conditions are now known to be physiological; in other words, it is not at all uncommon to find epithelial and hyaline casts and nuclealbumin in approximately one-half of all the newborn.

A brick-dust sediment not uncommonly appears about the third or fourth day of life, consisting of urates. This is the result of a deposit of uric acid or its salts in the kidney tubules.

The gastric digestion in newborn infants is well developed.

The gastric contents of unfed newborn infants consists of gastric juice which contains free hydrochloric acid. The average pH is 2.6; the buffer value, 9.4 c.c., and the volume, 4.5 c.c. At 5 days of age, test meals removed in 1 hour show an average acidity of pH 2.5, a buffer value of 10 to 12 c.c., and a volume of 6.5 c.c. Similar values were obtained on the tenth day. The capacity for gastric digestion is greater in newborn infants than later in infancy. Gastric digestion of 50 c.c. of partly skimmed cow's milk is practically complete in 1 hour. It would seem logical to feed newborn infants a more concentrated and a more alkaline food. Griswold and Shohl (*Amer. Jour. Dis. of Childr.*, Oct., 1925).

ASPHYXIA NEONATORUM.

DEFINITION.—By asphyxia neonatorum is understood that condition which results when the first respirations are not sufficiently well established to be involuntary and to support life. When the respiratory center is prematurely stimulated in the fetus,

attempts to breathe are made which often result in asphyxia. When asphyxia occurs, there is interruption of the normal interchange of oxygen and carbon dioxide in the infant's blood.

If the placental blood-supply is deficient or absent, or if the circulation of the mother is unusually weak, due to heart or lung disease, asphyxia may also result. It is most apt to occur in breech presentations. More commonly the condition is one of the accompanying symptoms of intracranial birth lesions, and it is, therefore, often a symptom of some other pathological process, the most common of which is intracranial hemorrhage.

SYMPTOMS.—Two distinct forms, which, however, must be regarded as merely different *degrees* of asphyxia, are observed.

Asphyxia cyanotica or **livida** applies to the infant who is cyanotic at birth, and makes little or no attempt at respiration. The respiratory act, if made at all, is shallow and ineffectual; an occasional noisy, gasping effort may be made. The features appear puffed, and the eyes almost closed, but there is no loss of muscular tone, and the reflexes are not abolished.

If no relief is obtained from the mechanical obstruction due to mucus, meconium, or amniotic fluid, which prevents the air from entering the lungs, the second form, or **asphyxia pallida**, follows. The heart's action becomes markedly enfeebled, and the face shows the pallor of death. Unlike the first degree, the muscle tone is lost, the reflexes are abolished, the sphincters relax, and the cord becomes almost pulseless and soft.

PATHOLOGY.—There is general visceral congestion, especially in the lungs, liver, and brain; the right side of the heart and its veins are engorged, and mucus, meconium, or fluid may be found in the air passages or in the stomach, as the result of respiratory efforts. The pathological picture is not unlike that found in death from immersion.

TREATMENT.—In the *livid form* the cord is not to be tied until pulsations can no longer be felt. Clear the air passages from any obstruction by mucus, and in such a way as to prevent aspiration of the latter. Stimulate the infant until it cries, using artificial respiration if the respirations are sluggish and intermittent.

If the *pallid form* is present, vigorous and heroic measures must be taken to save life. Cut and tie the cord, clear the upper respiratory tract, and stimulate by alternate immersion in hot (104° to 108° F.—40° to 42.2° C.) and cold water. The most effective drug to use to stimulate the respiratory centre is **alpha-lobeline**. One-twentieth grain (0.003 Gm.) may be given hypodermically, either into the muscle or into the vein. Quicker action is, of course, obtained by the intravenous injection. Hunt recommends dilatation of the sphincter ani with the fingers as an effective measure to stimulate respiration. If the results obtained are still unsatisfactory, persistent efforts for the induction of artificial respiration should be made.

Oxygen inhalations with a rubber tube inserted into the mouth advocated in premature babies with anoxemia, this measure having proved very effective in 2 instances. Bakwin (Amer. Jour. Dis. of Childr., Feb., 1923).

Where the fetal heart rate stays below 100 during 2 successive intervals between labor pains, denoting a beginning asphyxia, a favorable influence is exerted by administering 6 to 8 drops of **chloroform** per minute to the mother. The benefit is probably due to decreased tone of the uterine or abdominal muscles, thus permitting better fetal circulation. Willkomm (Munch. med. Woch., Dec. 18, 1925).

Sylvester's method is to be preferred to that of Schultze, as it is less apt to do damage to the infant.

Two striking results from the use of **pituitrin** in asphyxia pallida. In the first case, the woman had been in labor 2½ days. Upon delivery the child was exceedingly pale and limp, and made no attempt to breathe. Various methods of artificial respiration, tried without result, occupied about 20 minutes, by which time the infant appeared quite dead. The writer then injected 0.3 c.c. (5 minims) of pituitrin into the muscles of the buttock. In less than a minute the child gave a deep sigh, its skin began to flush, and within 5 minutes it was crying and breathing normally. The second case was very similar. Cormack (Brit. Med. Jour., Mar. 29, 1924).

In an asphyxiated infant the writer administered an **intracardiac** injection of **adrenalin** 5 or 6 minutes after the heart stopped beating, and was successful in resuscitating the child. Not over 0.5 c.c. (8 minims) should be injected in the newborn, and the injection must be given not later than 10 minutes after cardiac arrest. E. A. Koch (Zent. f. Gyn., Oct. 11, 1924).

Intracardiac injection of **pituitrin** in asphyxia neonatorum successfully used in a primigravida in whom the first stage took 15 to 18 hours. After 5 hours' delay, the axis-traction forceps having been employed, the child was born in a condition of white asphyxia, with the cord pulsating only feebly. In spite of all the usual measures, the heart failed to become

audible. Having only **puitritin** with him, the writer injected 0.25 c.c. (4 minims) directly into the heart, and continued **inflation respiration**. Within $\frac{1}{2}$ minute the heart began to beat, and so continued with increasing force. With further forced respiration the child eventually breathed satisfactorily. E. H. Rainey (Brit. Med. Jour., Apr. 26, 1924).

DeForrést's method commends itself, however, as simple and more effective, since it combines the advantages of heat with artificial respiration. This method is described by its originator as follows: Hold the head of the child between the thumb and index finger of the right hand placed on each side of the neck, with the baby's head to the right and lying upon the back. The baby's right or further arm is grasped well in the axilla between the index and the middle fingers of the same hand; the ring and little fingers are to be extended as far down the spine as possible to give the back support. The left hand holds the legs of the child, from underneath, by grasping the thighs, and with the index finger between the thighs for better security and control. With the child held in this manner it is at once immersed in the tub of hot water, which should be of as high a temperature as can be well borne, and held so that merely the face is out of the water. Expulsion of the air from the chest is then easily effected by flexing the thighs well over on the abdomen with the left hand, making firm counterpressure upon the back with the right hand to prevent the nostrils from being depressed below the surface of the water. Inspiration is next secured by overextension of the legs and of the neck, supporting the back with the fingers of the right

hand, as above described. The usual rhythm is, of course, maintained.

Following procedure for starting respiration advised: The thumb and fingers of the operator's left hand grasp the child's mastoids from behind. The right hand holds both ankles firmly from behind. The infant is held nearly vertical, say at an angle of 15 degrees, and is then allowed to move quickly downward by its own weight, feet first, about 2 feet. The abdominal viscera move down, the diaphragm is depressed, and inspiration is at once initiated. The infant is now lifted feet first upwards and to the right of the operator, being therefore head down, at an angle of 15 degrees to the vertical. It is then moved quickly downward, head first, about 2 feet. The abdominal contents fall against the diaphragm, which is thus pushed up, fully arched, so that expiration is completed. These movements are repeated about 15 times a minute. Even the first attempt will often elicit a sigh, if nothing more. Gentle handling is essential. W. O. Greenwood (Lancet, May 7, 1921).

An aspirator for the removal of mucus from the lungs of the newborn can readily be constructed from a breast-pump. Bunim (Amer. Jour. of Obst. and Gyn., Jan., 1925).

Carrel, of the Rockefeller Institute, has perfected an apparatus for **direct insufflation**, the pressure being controlled by a manometer.

The **pulmotor** has been tried in maternity hospitals with some success, but this is not achieved until the respiration is voluntarily continued over several hours without remission.

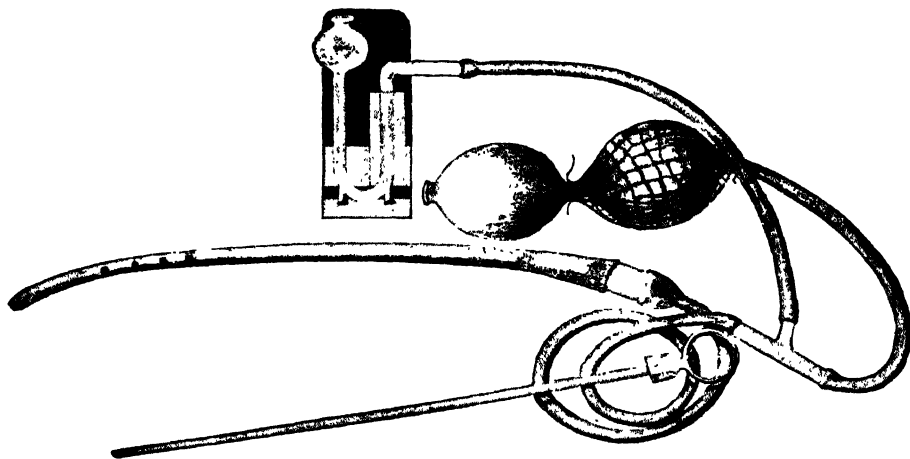
When respiration has been established, it is important to test the blood coagulation time in these cases because of the frequency of hemorrhages. In all cases where the coagulation time is slow, **whole blood** should be **injected subcutaneously**.

Heart massage as an aid to resuscitation of stillborn infants is best carried out with the infant lying upon its back in a wide basin filled with sufficient water at a temperature of 110° to 120° F. (43.3° to 48.8° C.), to completely cover the body, the head supported so that no water can enter the mouth or nose. Using both hands, grasp the body of the infant in such a manner that the thumbs rest upon the anterior surface of the chest, the fingers extending across the back, as in the Schultze

facial respiration efforts. Of course, the efforts would be in vain if the infant had been dead too long, or if, after starting the heart, normal respiration could not be established. E. LaRue (*Pediatrics*, March, 1914).

CONGENITAL ATELECTASIS.

DEFINITION.—This condition is characterized by the non-inflation of the fetal lung, in whole or in part. It occurs most frequently in feeble, immature infants, who have not the



Carrel's apparatus for insufflation of the lungs.

method of artificial respiration. The thumb of the left hand should cover the third intercostal space almost against the left border of the sternum, while the right thumb is placed over the fourth intercostal space directly in the mammary line. Now make deep pressure, first with the right thumb, which forces the blood out of both ventricles; from the right ventricle through the pulmonary artery to the lungs, and from the left ventricle through the aorta to the arteries of the body; then with the left thumb, causing both auricles to contract and forcing their blood into the ventricles. This alternate pressure should be made at the rate of one hundred per minute, until the heart is distinctly felt to beat of its own accord; then it is safe to start arti-

ability properly to expand the lung. The lower lobes, posteriorly, are the region most commonly so affected.

DIAGNOSIS.—The diagnosis is oftener made from the symptoms than from the physical signs. The percussion note, however, is somewhat impaired over the collapsed area, and on auscultation the breath sounds are feeble, and accompanied, occasionally, by fine, moist râles. In some cases the healthy lung obscures any definite physical signs.

The diagnosis may be made if, in addition to the signs enumerated, there is cyanosis which is not constant, in an infant with a feeble cry,

having cold extremities, and with a subnormal temperature. Feeble nursing and drowsiness are frequently observed. The above symptoms, even in the absence of physical signs in the chest, should suggest the possible presence of atelectasis.

PROGNOSIS.—Attacks of cyanosis and prostration may occur after several days of improvement. The prognosis is poor, success being attained only by energetic treatment and constant, skilled supervision.

TREATMENT.—The production of a good vigorous cry is a necessity. This can be accomplished by **mechanical stimulation** in the form of **spanking**, or **alternate hot and cold douches**, and the repetition of these stimuli if the child does not from time to time give a strong, vigorous cry. **Frequent change of position and careful feeding**, and maintenance of an **equable temperature**, are indicated. In severe cases, **artificial respiration** and the giving of **oxygen** are needed.

INANITION FEVER.

This term was applied by Holt to a group of cases, occurring usually in the first five days of life, in which there is an elevation of temperature due to partial or complete starvation—this in spite of the fact that the child has been placed at the breast. An ample, copious feeding causes the temperature to drop. Physical examination is negative, except for restlessness, dry lips and tongue, and a hot, dry skin. The usual duration of the fever is three days.

DIAGNOSIS.—A temperature chart, and a weighing before and after feeding, will assist in the diagnosis.

PROGNOSIS.—The prognosis is good when the condition is recognized and a sufficient feeding is given.

TREATMENT.—A change to a **wet-nurse** with full breasts (who has passed a physical examination), or, if this is impractical, **artificial feeding**, should be resorted to. Attempts should be made by **rest and diet** to **increase the amount of the mother's milk** before this is entirely abandoned.

High external temperatures seem to increase the incidence of fever among newborn babies. Additional factors, apparently, are the subnormal fluid intake and excessive loss in weight characteristic of babies having fever during the newborn period. The prompt subsidence of the fever on liberal administration of **fluids** strongly suggests that dehydration is an important causative factor. F. L. Adair and C. A. Stewart (Amer. Jour. Dis. of Childr., June, 1926).

Report of 50 cases indicating that newly born infants, as a rule, gain better when fed additional food in the form of **lactic acid milk** until sufficient breast milk is supplied. The milk is rendered more digestible by being sour, and more food can be handled. Milk soured in other ways is probably just as good; for many years the authors have not infrequently used **butter-milk**, when additional food is needed for the newborn. The usual formula has been: Holstein milk (whole), 8 ounces; lactic acid, U. S. P., 15 drops; water, 8 ounces; dark corn syrup, 1 ounce. The milk is boiled gently for 5 minutes, the scum removed, and to each 8 ounces of the cooled milk are added 15 drops of the acid, the milk being stirred when each drop is added. This formula is given to infants only during the first 3 or 4 days of life, or until the breast milk is established. Neff and Dillon (Jour. Kansas Med. Soc., May, 1926).

DEHYDRATION.—Stress has been laid by many authors on the dangers of lack of water in newborn infants. According to Meier, the lack of water, especially in the breast-fed, may be due to loss of appetite and refusal of milk on account

of some infection, even a slight cold. The clinical picture markedly resembles that of alimentary toxicosis. The quickest therapeutic results were obtained, in Meier's experience, by introducing into the stomach through a catheter in the nose 150 c.c. (5 ounces) of a carbonated mineral water at 100° to 104° F. Bakwin and Goss concluded, from a study of 50 cases of fever in the newborn, of which 47 suggested the classic inanition fever, that fever in the newborn differs from fever due to infections in that it is associated with diminution of the water in the blood plasma. In most cases treated with water or dextrose solution, given by gavage, *e.g.*, 1 ounce (30 c.c.) of 5 per cent. dextrose solution or 190 c.c. (6 ounces) of water, at a temperature above that of the body, the temperature fell several degrees in 30 to 60 minutes.

BIRTH INJURIES.

The newborn child may sustain injuries during its birth as a result of abnormal placental blood-supply or from compression of the cord. As LaFétra has pointed out from a study of the Sloane Hospital records, a tight cord around the neck may superinduce intracranial hemorrhage. Most of such injuries, however, are the result of *disproportions between the child and the birth canal*. Assistance rendered by the physician or attendant at birth and forceps operations are responsible for many of the injuries. Williams gives an infantile mortality of 60 per cent. in high forceps cases. The operation of version, next to the forceps, is responsible for many accidents, such as fractures, hematomata, meningeal hemorrhages, atelectasis, and pressure paralyses.

Study of 500 brains of newborn, premature, and breast-fed infants, as well as of various animals. Intracranial hemorrhages proved quite common, and occurred in characteristic localities. In 65 per cent., the pathologic change was microscopic. There was definite correlation be-

tween the microscopic findings and the age at death, *viz.*, from 24 to 48 hours, 2 to 4 days, 6 to 8 days, 8 to 12 days, 2 to 3 months, 3 to 18 months, and 18 months. Included were cases of Little's disease, Cesarean babies, idiots, cases of spontaneous nystagmus, and acephalic monsters. Fischer (Schweiz. med. Woch., Oct. 2, 1924).

In autopsies of 300 newborn infants, hemorrhages due to trauma were found in 92 per cent.; due to other causes, in 8 per cent. Of the trauma group 60 per cent. showed tentorial tears. Of full term infants dying postpartum, 90 per cent. showed hemorrhages. After the first day, in a small group that lived and showed hemorrhage, 31 per cent. had tears and 54 per cent. hemorrhage, giving a total of 85 per cent. of traumatic hemorrhage. In the term infants, 67 per cent. showed tears and 11 per cent. hemorrhage of the dural folds. Examination for blood in the cerebrospinal fluid, pia-arachnoid, or ventricles showed trauma in 91.9 per cent. of all infants from intra-uterine life to 14 days postnatal. In other infants, where the dura was not torn, 55 per cent. showed tears and 45 per cent., hemorrhage. W. A. O'Brien (Amer. Jour. Dis. of Childr., Mar., 1925).

During delivery the head is subjected to generalized compression, then to molding; in addition, the contractions of the uterus above force the spine against the base of the skull. An accurate history of the labor is of great diagnostic importance. So-called normal labors quite frequently are associated with evidence of both hemorrhage and laceration. After short, violent labors, and also prolonged labors, definite laceration and hemorrhage have been found, and the babies usually die neonatal deaths. F. L. Adair (Amer. Jour. Dis. of Childr., Mar., 1925).

As many as 75 per cent. of birth injuries are avoidable. Statistics indicating a lowering of fetal mortality rate are said to be misleading, as this reduction is due to better pre-natal

care, which eliminates deaths from toxemia and other preventable causes. Birth injuries are still responsible for a large number of fetal deaths. J. W. Newman and W. E. Levy (Amer. Jour. of Obst. and Gyn., May, 1926).

CAPUT SUCCEDANEUM.

This fairly common condition, occurring as the result of compression during the act of parturition, consists in the production of a doughy mass with edema over the parietal or occipital bone; it is made up of an infiltration of serum and blood between the periosteum and the scalp. Without any special treatment the tumor is absorbed after a few days.

CEPHALHEMATOMA.

This consists of a rounded mass, usually developing about the second or third day on the cranial vault as a result of a subperiosteal hemorrhage. The overlying skin is movable and slightly edematous; more rarely there are seen pressure areas or evidences of hemorrhage. The sense of fulness on palpation soon subsides and fluctuation can be made out. Characteristic of this type of injury is the fact that it never passes beyond the limits set by the sutures of the bone (due to adherence of periosteum at sutures). A ring of newly formed bone tissue develops about the base of the tumor, which gives the impression of a crater-like opening. As the blood absorbs, the periosteum becomes more closely approximated to the cranial bone. The time of absorption is variable, from a few days to several weeks. There is little evidence left except a thickening of the periosteum after healing has taken place. If suppuration has developed, however, due to infection, abscess formation results and the other added symp-

toms of general sepsis appear. Locally, the neighboring cellular tissue is involved; in some cases the denuded bone is affected.

DIAGNOSIS.—A *traumatic meningocele* can be distinguished from cephalhematoma by the fact that it can be reduced by pressure, and that it fills when the child cries.

PROGNOSIS.—There is a tendency to restitution in all cases; even in those which become infected, life need not be endangered if active treatment is applied.

TREATMENT.—Under a **protective dressing** made in the form of a sterile cotton ring and gauze cap, the tumor subsides in the majority of cases. When the mass is large and difficult to control, **incision and drainage** can be practised. Good results will be obtained if **strict surgical cleanliness** is followed, with **shaving of the head**, etc., as a preliminary procedure. *When suppuration is present*, as shown by heat, pain, redness, and swelling, one should **incise at once** and apply **moist antiseptic dressings**.

INJURIES TO THE BONES OF THE HEAD.

Injuries to the bones of the skull are not frequent, because of the fact that the skull is able to be molded from pressure, and the cranial bones overlap at the sutures. At times, however, impressions are made in these bones. These may be divided into spoon-shaped impressions and grooved impressions. The former are more superficial, while the latter are deeper, with sharper margins. These impressions occur most frequently in the parietal bone. Occasionally fractures of the calvarium occur in the frontal or parietal bones.

TREATMENT.—The spoon-like impressions gradually disappear without treatment. The grooved impressions, however, are permanent unless corrected by operative procedure, which consists in **elevating the depressed part** from the outside. This operation is usually performed with a small cork-screw instrument or a borer.

FRACTURE OF THE CLAVICLE is a comparatively frequent injury, and often overlooked. With the arm held away from the body, crepitation may be elicited.

MUSCLE INJURIES.

The sternocleidomastoid muscle is peculiarly liable to injury at birth. Evidence of such injury appears after several days in the form of a fairly hard tumor, generally in the sternal part of the muscle. Usually the chin rotates toward the healthy side. This condition is more apt to occur in breech than in vertex presentations and is the result of rupture of the fibers, or of hematoma formation from undue traction on the muscle.

PROGNOSIS.—This is good, as a rule, the tumor rarely persisting after the second month.

TREATMENT.—**Massage** three times a day will assist in the absorptive process. We have found light **vibratory massage** of great assistance. *In neglected cases* firm, **passive movements** to the unaffected side, with the body fixed, will relieve the torticollis.

BIRTH PARALYSES.

These are either *cerebral, spinal, or peripheral*. Certain causes at parturition may produce any one of these forms, *viz.*, prolonged, tedious labor with improper traction, instrumental deliveries, breech extractions, and

premature delivery. Unfortunately spinal paralyses do occur; such injuries cause various forms of paraplegia, the symptoms differing according to the location of the area of the cord involved. Spinal and cerebral injuries may result when undue force has been exerted in delivery.

CEREBRAL PARALYSIS.

SYMPTOMS.—The symptoms necessarily vary with the amount and location of the hemorrhage. A small extravasation may produce a fleeting hemiplegia, while a copious bleeding will result in a stillborn child. Stupor, with shallow, irregular respirations, is noted. If convulsions follow, the lesion probably involves the motor areas. Since the meninges rarely escape, symptoms and signs such as are commonly found in involvement of the membranes are observed, *viz.*, twitching of the muscles of face, fingers and extremities, somnolence, cyanosis, and inequality of the pupils, opisthotonos, Kernig's sign, nystagmus, spasticity of muscle groups, or complete flaccidity of the body. The fontanelle may be found bulging, due to extravasated blood, and this is a valuable indication for lumbar puncture.

ETIOLOGY.—In addition to the causes mentioned under the general heading as common to all forms of birth paralysis, there may have occurred bleeding in the brain, as in "hemorrhagic disease of the newborn." That syphilis may be a predisposing cause cannot be denied, but the fact remains that many infants, particularly the first-born, are permanently injured at birth, and those surviving the injury appear later with the end-results—hemiplegia, spastic paralyses, and various grades of men-

milder types of involvement. Improvement begins about the end of the first week and should be completed by the third month. When the lower arm is affected, however, the prognosis is serious.

TREATMENT.—The most important measure is **absolute rest** for the first few days; all unnecessary manipulations of the shoulder joint must be avoided. The arm should be kept **warm** and should be placed in a **position to relieve all tension** on the nerve trunks. Some type of **light splint** is essential to obtain complete rest. In 2 weeks, **light massage and passive movements** may be started. By the fourth week, **faradic treatment** may be begun. These treatments must be very short at first, and gradually increase up to 10 minutes. The massage and electrical treatment must be persisted in for a long period to obtain results. Between treatments, the arm must be kept on a splint in order to prevent pull on the paralyzed muscle.

Stubborn cases will require active, systematic treatment to prevent a permanent paralysis of the deltoid. While the measures above mentioned will do much to prevent disability, **nerve suture** must be considered in cases which have resisted treatment and show no tendency to a return of functional ability. Taylor recommends operation before the third month, and in cases where roots have been torn from the cord, these must be **laterally implanted into the neighboring roots**; or, if the latter have been damaged enough to require resection, all the **distal nerve-trunks** may be **sutured** in a bunch to the proximal root still attached to the cord.

INTESTINAL TOXEMIA.

This is a clinical entity which is rarely fatal, but not uncommon. It was described in, and gained recognition through, a monograph by Morse.

SYMPTOMS.—The symptomatology and diagnosis have been described by Morse as follows: A baby that was normal at birth and has continued to seem normal and to do well up to the second, third, fourth, or even fifth day becomes rather suddenly ill. He is likely to cry and moan considerably. Attacks of cyanosis are a common and early symptom. Twitching of the extremities, slight general rigidity, and retraction of the head come on in many instances, while convulsions are not infrequent. The temperature is, as a rule, only moderately raised, but may be high. In more severe cases the baby refuses to nurse. Vomiting is uncommon. In some instances there is no diarrhea, but the stools are usually small, loose, dark brown and contain small, soft curds and mucus, often offensive. Loss of weight is generally rapid, the face becomes pinched, and the baby is seriously ill.

DIAGNOSIS.—The diseases for which this condition is most likely to be mistaken are cerebral hemorrhage the result of injury at birth, meningitis, hemorrhagic disease, and septic infection.

The diagnosis from *septic infection of the newborn* is the most difficult. The symptoms appear earlier, as a rule, than do those of septic infection, and the temperature is usually lower than in sepsis. There is no local nidus of infection, and marked general and local symptoms of infection, such as hemorrhages, deep jaun-

dice, and furuncles, are absent. There is a tendency to constipation and the stools are usually meconium-like

Hemorrhagic disease of the newborn can be excluded on the absence of hemorrhages.

Meningitis is extremely rare at this age and, when it occurs, it is a part of a general septic infection. There is almost invariably bulging of the anterior fontanelle in meningitis and usually when there is a *cerebral hemorrhage*. There are usually symptoms of focal irritation in hemorrhage, and often blood in the nose and nasopharynx, while in both cerebral hemorrhage and meningitis there is likely to be spasm of the extremities and exaggeration of the knee-jerks. A lumbar puncture will settle the diagnosis at once in a doubtful case.

ETIOLOGY.—The condition is attributed to a bacterial infection, with undue permeability of the intestinal wall, which renders the newborn susceptible to intestinal toxemia. The intestinal mucous membrane is easily irritated by bacterial infection, especially if the breast milk contains an unusually high sugar percentage. Products of the bacterial activities are absorbed into the circulation and cause the symptoms. That the condition is not analogous to the *inamtion fever* previously described is shown by the fact that intestinal toxemia occurs in infants that have had a full feeding. It is well to remember, however, that underfeeding may produce diarrhea; but if there are more than 3 bowel movements in a day, the diarrhea is usually due to a bacterial infection.

TREATMENT.—Bowel irrigation and catharsis with castor oil, stopping of all food for 12 hours, and the

substitution of plain water are advised. **Breast milk** is best after the period of starvation, or, if breast milk is not available, **protein milk** should be given.

ICTERUS NEONATORUM.

This is a common affection. A mild form of it is seen in many infants, otherwise in good health, soon after birth. Cruse found it in 84.4 per cent. and Holt reported it in 83.3 per cent. of all births. The commonly seen yellowing of the skin, due to the intense congestion observed soon after birth, without discoloration of the conjunctiva, is too benign to deserve consideration here.

SYMPTOMS.—The designation *true icterus* is applied to those cases in which the skin has been stained by the bile pigments. This occurs most frequently in premature or feeble infants born asphyxiated. It is usually not noticeable until the second or third day. The face is first affected and later the skin of the body. The urine remains free from bile pigments, but microscopic examination reveals masses of dark pigment known as the *masses jaunes* of Parrot and Robins (Cruse showed these to consist of bilirubin).

This type of jaundice seldom lasts more than from seven to ten days. An icterus that persists beyond this time is probably one of the more serious forms, and constitutional symptoms will supervene, if they have not done so already. In this milder form there are few or no toxic symptoms. The infant is apt to be sleepy and takes less interest in nursing, and the pulse is not slowed, as in the adult forms of jaundice.

DIAGNOSIS.—This must be made from the more serious forms, which

may be due to congenital malformation, sepsis, or syphilis. Fortunately these forms are rare. Their distinguishing characteristics are as follows:—

Septic Type.—The infant shows constitutional involvement. The portal of entry is usually the umbilicus, although the bile itself may carry the infective agent. The child is seriously ill and the temperature is high, the jaundice persisting beyond the second week.

Malformations.—Jaundice due to congenital obliteration of the bile duct or malformation of the gall-bladder, with or without cirrhosis of the liver, is fatal. The jaundice may not appear until the second week, varying in intensity from time to time. The fecal discharges are clay colored and offensive; the urine contains bile pigments, but no urobilin. The spleen enlarges with the liver, accounting for the prominence of the abdomen. Spontaneous bleeding occurs in some of the cases, and usually hastens a fatal ending.

Syphilitic Type.—Jaundice accompanying other evidences of syphilis makes the outlook particularly grave. The jaundice is usually present at birth and is quite intense. Hemorrhages from the skin or mucous membranes may occur, and unless vigorous **antisymphilitic treatment** is instituted early the infant fails steadily. The Wassermann reaction will clear up a doubtful case.

Familial Jaundice.—This is a rarer form which is characterized by the appearance of icterus in successive children of the same parents. A profound jaundice, developing rapidly, appears within a few hours of birth. The infant sinks into a lethargic con-

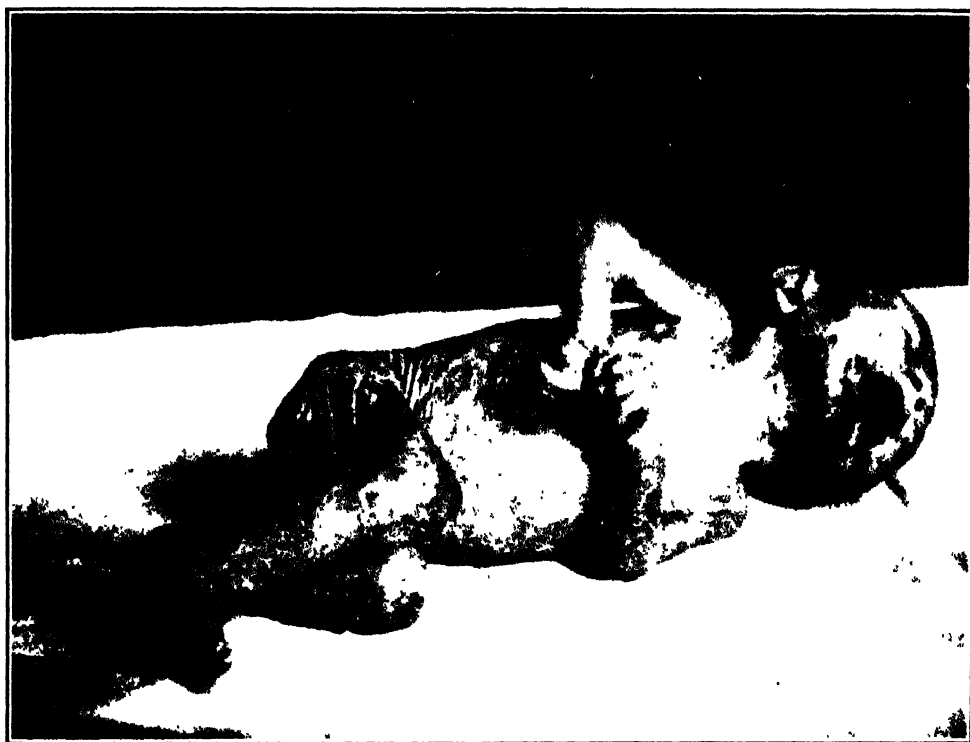
dition and may have convulsions before the fatal ending is ushered in. Those who recover suffer from a prolonged and resisting anemia. This type is very fatal; Auden reported 8 deaths out of 31 cases.

ETIOLOGY.—That jaundice may be hematogenous in origin is hardly tenable in the light of modern researches. It has been proven experimentally that jaundice cannot be induced if the liver has been extirpated (Minkowski and Naunyn), nor has free hemoglobin ever been found in the circulating blood of the newborn. In transfusions of whole blood into infants, jaundice has never followed. Knöpfelmacher holds that the bile-capillaries are blocked by tenacious bile, which, being unable to flow out, gets into the blood-stream.

According to Hallez, icterus of the newborn is due: 1. To a transient functional liver insufficiency with increased bile pigment in the serum. 2. To an increased destruction of the red blood cells, with further liberation of bile pigment in the serum.

In a study of icterus neonatorum by means of the duodenal catheter, Hess found that bile is very rarely excreted during the first 12 hours of life. During the subsequent 24 hours, in cases of marked jaundice, it is profuse; in cases not jaundiced, it is scanty or absent. The function of excretion gradually becomes fully established during the first week or 10 days of life.

Jaundice precedes the excretion of bile into the duodenum. Secretion of bile is, in general, marked when jaundice is marked. Jaundice usually results from inability of the rudimentary excretion to cope with the sudden profuse secretion of bile. At the time when excretion has completely assumed its function throughout the body, a sudden flood of bile is poured into the passive excretory ducts and gains access to the hepatic circulation.



Syphilitic Form of Icterus Neonatorum.

The lymphatic distribution, as well as the vascular supply, determines the distribution of the bilirubin pigment in the skin in icterus neonatorum. It is distributed much as the exanthem of measles. The pigmentation does not increase once it has begun to recede. There probably occurs a single overflow of bilirubin. The bilirubin in the serum of the umbilical cord at birth and that produced in the first 2 or 3 days suggest that the etiologic factors are active before birth. The pigment is found in greatest concentration in the heart blood; the closer to the heart, the more pigment in the tissues, except in irritated skin, where pigmentation is always deeper. B. Schick (Zeit. f. Kind., xxxviii, 513, 1924).

Although the subject has received a great deal of study by many observers, it will be seen from the above variety of opinions that the etiology of icterus neonatorum is still unsettled.

TREATMENT.—In the milder forms of jaundice, practically no treatment is required, while in the cases due to congenital malformations no treatment is of any avail.

In the form associated with syphilitic hepatitis the early injection of neoarsphenamin may save life. It should be repeated at least once, and then followed by the older forms of treatment,—1 grain (0.06 Gm.) of **gray powder** 3 times a day, supplemented, if necessary, by mercurial inunctions.

On the plea that hyperacidity is often the cause of jaundice in the newborn, the writer uses sodium bicarbonate in these cases, apparently with good effect. R. A. Poynton (Ill. Med. Jour., June, 1924).

Administration of calcium ions recommended. In cases with ominous cholemic intoxication in infants, splenectomy is indicated to save life.

Greil (Zeit. f. Geb. u. Gyn., Apr. 21, 1925).

Slow weight gain, poor nursing and digestive disturbances attend icterus neonatorum. The condition is more common in premature infants and lasts longer in them. The cord blood in all newborn infants shows an increase in bilirubin. The intensity of the icterus is not always an index of the concentration of bile pigment in the plasma. The icterus is to be ascribed to impaired excretory function of the liver, causing an abnormal accumulation of bile pigment in the blood. **Cinchophen**, claimed to increase the bile and render it more acid, was used in 72 cases, with encouraging results. Of these cases, 79 per cent. had recovered when discharged from the hospital on the twelfth day. Of 50 infants not treated, only 32 per cent. had recovered at this time. H. Slobosiano and P. Herscovici (Nourisson, Nov., 1925).

TETANUS NEONATORUM.

Tetanus is an acute infection caused by the *Bacillus tetani* and characterized by violent muscular spasms, usually affecting, besides the great muscles, those of the jaw.

SYMPTOMS.—These usually begin about the fifth day, and rarely after the second week. The infant is markedly fretful, and soon a disinclination to nurse is noticed. Closer examination will reveal that this inability to nurse is due to a stiffness or rigidity of the jaws, i.e., *trismus* is present. The body is next involved, and the head thrown back, with short periods of relaxation; tonic convulsive movements may end in complete rigidity and opisthotonos. If any relaxation occurs, handling brings on a renewed spasm. The temperature increases as the exhaustion progresses.

ETIOLOGY.—The infective agent usually gains entrance through the

umbilical wound, or through skin abrasions on the body of the infant. The soil, particularly in association with stables, affords the medium for inoculation in a marked degree. The disease very rarely occurs in an urban population.

PROGNOSIS.—This is one of the most fatal diseases of infancy, the mortality being probably about 95 per cent. Fatal cases rarely live

It should be administered intrathecally, intravenously, and subcutaneously; 2000 units should be given in each of the above ways as the initial dose, and this can be repeated within 24 hours. Unless the toxins can be neutralized and prevented from injuring the nerve-cells, the treatment will be of no avail.

Full doses of **potassium bromide** and **chloral hydrate**—2 grains (0.12



Tetanus in the newborn, showing trismus.

more than 48 hours. The later the phenomena appear, the better the chances. Death takes place from embarrassment of the respiratory muscles and exhaustion.

TREATMENT.—**Prophylactic.**—**Aseptic dressings and handling** should be carried out until the umbilical wound is thoroughly healed. Local **antiseptics** should be applied if any signs of suppuration appear after separation of the cord.

General—**Antitetanic serum** should be administered at the earliest possible moment, to neutralize the toxins.

Gm.) of chloral and 5 grains (0.3 Gm.) of bromide every 3 hours by rectum—should be given; or, 20 grains (1.3 Gm.) of **calcium bromide** may be administered by the mouth or the nasal passages. Except for **nasal feeding** and medication, the **infant must not be disturbed** in any way.

In tetanus neonatorum the writer recommends **antitetanic serum** subcutaneously and intraspinally; subcutaneous injections of 5 c.c. (80 minims) of 4 per cent. **magnesium sulphate** solution, at first twice daily, then gradually reduced to once on alternate days as the patient im-

proves, and also chloral hydrate, to enhance the action of the magnesium. A. Bratusch-Marrain (Arch. f. Kind., Mar., 1924).

OPHTHALMIA NEONATORUM. (See page 563 in Volume III).

PEMPHIGUS NEONATORUM.

This is a disorder affecting newborn infants, contagious in character, and occurring often in epidemic form.

SYMPTOMS.—The first indications of its presence are punctate red macules, which soon enlarge. Formation of vesicles then begins. These are apt to open before reaching their full size, a distinct areola forming about them, with a denuded skin surface when the vesicles burst.

The contents of the bullæ is a yellowish liquid. The lesions are apt to appear synchronously or in widely scattered crops. The principal regions affected are the abdomen, inguinal regions, and axillæ; occasionally the mucous membranes of the mouth and lips are involved. The scalp is usually spared. A secondary infection sometimes causes suppuration in the bullæ.

In the milder cases the general condition of the infant is only slightly affected, but in the graver forms constitutional symptoms, with anorexia, vomiting, and tympanites, are noted.

DIAGNOSIS.—The disorder is to be distinguished from a *syphilitic pemphigus* (more properly a bullous syphiloderm) which affects the palms of the hands and the soles of the feet, while in the non-syphilitic variety these regions escape. Thus, the luetic variety can be differentiated by its distribution, by the other evidences of syphilis, and by a Wassermann reaction. Spirochetes have been found in the bullæ, which, furthermore, leave

a rusty or ham-colored base behind them.

ETIOLOGY.—Maguire showed that in every fatal case the umbilical stump had been infected. Pus organisms are transferred by midwives or attendants to the newborn, thus spreading the infection.

TREATMENT.—The blebs should be punctured by a fine sterile needle and the contents absorbed with cotton. The lesions may next be painted with a 2 per cent. solution of **mercurochrome**. A dressing with **boric acid** or **zinc stearate** is then applied. If systemic symptoms appear, **stimulation** is necessary. **Breast milk** is essential, and water should be given freely between nursings.

In furunculosis and pemphigus in children, Reiche has applied on a large scale **Lewandowsky's** method of dislodging the staphylococci from the horny layer. This is accomplished by **vigorous sweating**; the staphylococci thus drawn forth are then killed by immersing the child in a bath of 1:10,000 solution of **mercuric chloride**. The child is first given a hot bath and then the **pack**, with warm drinks, and, possibly, from 0.2 to 0.3 Gm. (3 to 5 grains) of **acetylsalicylic acid**. Furuncles are opened and sponged out in the bath and the body lightly rubbed. The child is then rinsed off, wiped dry, and dusted with **talcum powder**. This is repeated daily for 2 or 3 days, the loss of fluids being compensated by plenty of warm drinks. The method gave excellent results in acute pemphigus of the newborn, supplemented by application of a mixture of 5 parts **ichthyol** and 5 parts **glycerin** in 100 parts water.

Certain outbreaks seem traceable to an initial case infected with *Staphylococcus aureus* by its own mother's milk. This occurred 3 times in sporadic cases that might have caused outbreaks had not the mothers been segregated, while in a third sporadic case an outbreak of 10 cases actually resulted. A similar outbreak was

traceable to a burn infected with *S. aureus*. When this organism is rampant, it may be present in the milk and even the blood of certain mothers with few or no symptoms, who may be viewed as "carriers." Case-to-case contact is undoubtedly the common method of transmission in institutions, but it seems best to isolate both mother and child when there is proof that the mother harbors the infecting organism. Mellon, Caldwell and Winans (Amer. Jour. Med. Sci., Mar., 1925).

SCLEREDEMA.

Much confusion has resulted from descriptions of this condition based upon the known symptomatology and pathogenesis of scleroderma of adults. Pediatricists distinguish two conditions having their own separate identity, viz., *scleredema (sclerema edematosum)* and *sclerema (sclerema adiposum)*.

SCLEREDEMA, although not common, is oftener seen in this country than sclerema.

Symptoms.—After a few hours of depressed heart action and irregular, shallow breathing, edema appears in small areas in various parts of the body, which increase in size. The infiltrated areas are easily recognized, as their margins are distinct. The swellings are common on the dorsum of the feet, the face, and over the symphysis; next the entire lower extremities become edematous, the genitals are swollen, but the chest may remain free for a time at least. The skin is either mottled, cyanotic, or deadly white; on palpation, it pits and gives an indurated, putty-like feeling—the consistency of dough. The temperature is usually subnormal, and systemic disturbance is noted by marked apathy and anorexia. The urine, although scant, does not contain albumin. The weight may re-

main stationary or even increase, owing to the infiltration of the subcutaneous tissues and underlying muscles with a fluid exudate. Collapse supervenes unless treatment retards the progress of the condition. The temperature may drop to 95° F. (35° C.), and in one case observed by Pisek the dairy thermometer used registered 84° F. (30° C.).

Etiology.—Scleredema affects well nourished infants during the first week of life, and is prevalent chiefly in the winter months. The lowering of the body temperature during this period, with its influence on the metabolism of the unorganized infant, is probably the exciting cause, along with the other usual causes of edema.

Prognosis.—The prognosis is grave in those infants in whom the edema spreads rapidly and is extensive. Mild cases often react favorably to treatment.

Treatment.—Maintenance of the body heat to the normal should be the first consideration. This is best accomplished by keeping the infant in a **premature infant's bed** and by **warm baths**, the water of which is raised gradually until the child is in a hot bath of 105° F. (40.5° C.). The bath should be given for 20 minutes out of every 2 hours, if necessary, with **gentle massage with oil**, and the **extremities wrapped with cotton**.

The recommendation of Badaloni to use **inunction of glycerin** with 10 per cent. of **ammonium iodide** is worthy of a trial. **Breast feeding**, or at least breast milk given by a Breck feeder, if the child is too weak to suckle, is quite essential.

SCLEREMA.—This is a very rare affection which occurs in the new-

born, but is not restricted to this period.

Symptoms.—The lower extremities and face are the first to be involved with a diffuse infiltration. The calves, in particular, are noticeably affected. The condition then spreads upward over the thighs, trunk, and neck, but the palms of the hands and soles of the feet are not affected. It has a selective action on the portions of the body richest in fat. The skin soon becomes inelastic, firm, board-like, and has a stretched appearance; it does not pit on pressure. Movements are restricted because of the attendant rigidity of the skin and subcutaneous tissue.

Constitutional symptoms are always present; the temperature is markedly subnormal; the urine becomes scanty, but no albumin is found; the tongue and mucous membranes become dry, the face immovable, and if the child lives long enough the involved areas become atrophic. Purpuric or ecchymotic areas appear in the skin. Nutrition being interfered with, weight is rapidly lost; the pulse and respiration become abnormally low, and coma or convulsions may precede the exitus.

Diagnosis.—Sclerema is distinguished from *scleredema* by the absence of swelling, the absence of pitting of the skin on pressure, the indurated, hard, wax-like feeling in the tissues, and the profundity of the systemic involvement.

Etiology.—Sclerema has been observed up to the sixth month of life. It is sometimes secondary to the infectious diarrheas, and is possibly due to a bacterial infection.

Pathology.—At autopsy no characteristic gross changes are found. The

skin is hard and dry, and no fluid escapes. Harrison, on the basis of 4 postmortem histological examinations, states that the subcutaneous fat shows evidence of chronic inflammation and repair with giant-cell formations. In each case, there were abundant anisotropic crystals in the fat and lying free. The Roentgen ray revealed opaque deposits. The melting-point of the subcutaneous fat was raised slightly and there was an increase in the total cholesterol, but the iodine and saponification values were similar to control cases of corresponding ages. These findings uphold the view that sclerema is a primary inflammation of the subcutaneous tissues of unknown cause.

Knöpfelmacher concluded that the disease was made possible by the fact that the fat of newborn infants contains approximately 20 per cent. less oleic acid than in later life, while the palmitic and stearic acids, which congeal at a higher temperature, are present in greater amount in the nurslings.

Prognosis.—This is invariably grave in the newborn, particularly when the condition is secondary to a gastroenteric infection.

Treatment.—This consists in restoration of the body heat by **hot baths**, and the hypodermic injection of **normal saline solution**, 2 to 3 ounces (60 to 90 c.c.) every six hours, or, when practicable, the injection of **human blood-serum**, 5 fluidrams (20 c.c.), preferably from a parent. The latter serves not only the same purpose as the saline, but is further of advantage because of its nutritive value. **Caffeine** hypodermically is helpful in maintaining a proper degree of stimulation.

SPONTANEOUS HEMORRHAGES IN THE NEWBORN.

Bleeding during the first days of life is the cause of many deaths or permanent injuries. It is much more frequently present than was formerly recognized.

The term *hemophilia neonatorum* as applied to the whole group of *spontaneous* hemorrhages must be discarded; true hemophilia is very rarely manifested in the newborn. Spontaneous hemorrhages, or the so-called "hemorrhagic disease," must be sharply differentiated from the accidental, or traumatic, hemorrhages incident to the process of delivery.

SYMPTOMS.—The onset usually occurs before the tenth day, and often as early as the second day. The umbilicus is the most common seat; the intestines, mouth, stomach, conjunctiva, and ears (Ritter), in the order given, follow in frequency. Where infants are closely observed, premonitory symptoms will be noted; otherwise the first indication may be the bleeding. Before this takes place, however, the infant will be restless, refusing to suckle, and may have abdominal pain.

The external hemorrhage may be associated with varying degrees of internal hemorrhage. A preceding high temperature is unusual; vomiting or diarrhea is the rule. The type of hemorrhage varies considerably; it may be so massive as to cause death within a few hours, or there may be only a slight intermittent oozing. General prostration and symptoms of collapse will vary with the extent and rapidity of the bleeding.

Bleeding from the intestinal tract, commonly designated as *melen* *neonatorum*, will be evidenced by quite

characteristic stools and vomiting of disintegrated blood.

In syphilitic cases the bleeding is rarely profuse, and is often nasal in origin. Other evidences of lues are generally to be found. The urine is occasionally blood-stained, while the skin and subcutaneous tissues are subject to subcuticular hemorrhage at points of pressure, or from careless handling.

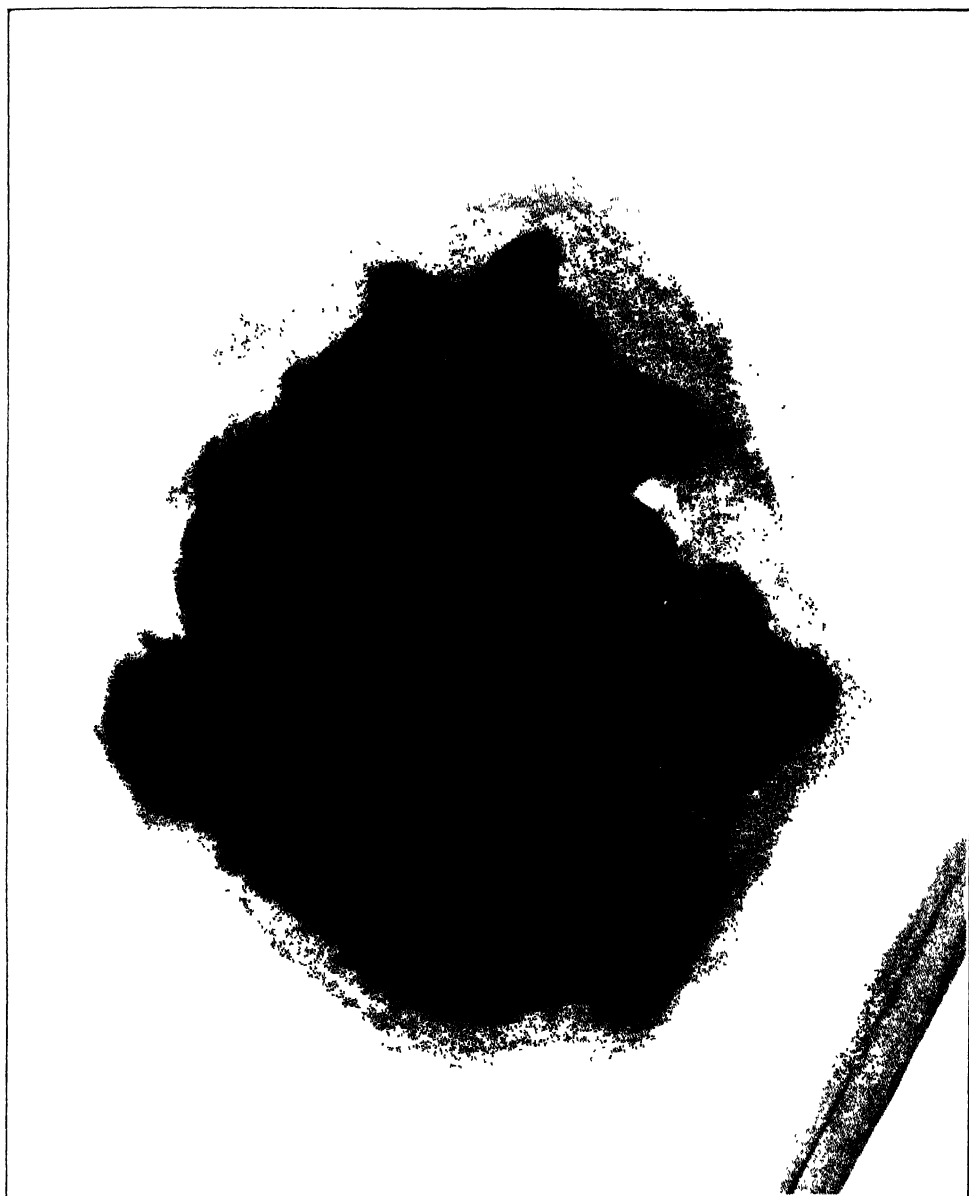
ETIOLOGY.—The trend of opinion points strongly toward bacterial infection, delayed or lost blood coagulation, and syphilis, as the principal factors of spontaneous hemorrhage to be considered. The luetic condition is a predisposing one, and in some cases no other satisfactory cause can be found. Writers also have attributed these hemorrhages to abnormal conditions of the blood, such as loss of the prothrombin-antithrombin balance, or of the vessels themselves.

Hemorrhagic conditions of the newborn may, according to Hamill, in certain instances be due to some of the causes formerly held accountable for all such manifestations, among these being birth trauma, fetal malformations, asphyxia, and syphilis. In the vast majority of instances, however, they may be considered symptoms of an infectious condition. Strong evidence of the infectious nature of melen, Winckel's disease, etc., rests in the fact that they are observed almost exclusively in institutions, and not uncommonly in epidemic form. The streptococcus, *B. coli communis*, and staphylococcus are the organisms most commonly encountered.

The following classification, arranged by Langmead, is serviceable for purposes of differentiation of the various types of hemorrhages:—

A. Those mechanically produced at birth:—

1. Cephalhematoma.
2. Intracranial hemorrhage.



3. Hematoma of the sternocleidomastoid muscle.
4. Visceral hemorrhage.
- B. Vaginal hemorrhage.
- C. Umbilical hemorrhage.
- D. Hemorrhage due to infection:—
 1. Syphilis.
 2. Septic.
 3. Epidemic hemoglobinuria (Winckel's disease).
 4. Buhl's disease.
- E. The "hemorrhagic disease."
- F. Hemorrhage due to severe jaundice.
- G. Hemophilia.

PATHOLOGY.—The necropsy findings show no gross changes except the localized hemorrhages, or anemia of the organs due to general loss of blood. The intestinal canal may contain blood in various stages of decomposition, and its mucous membrane may show areas of ecchymosis. Those in which ulcers of the stomach or intestines have been found were probably cases with inflammatory changes.

[According to Ehrenfest, there has been a tendency to lay undue stress on hemorrhagic diathesis in the causation of birth hemorrhage. The widespread significance of artificial, mechanical and physiologic trauma incident to birth is being underestimated. The more carefully postmortem examinations are made, the more frequently are evidences found of unsuspected injuries to the meninges and other structures.

Dr. Margaret Warwick, as a result of autopsies on newborns, concluded that cerebral hemorrhage is frequently found, occurring in 50 per cent. of 36 deaths of young infants. It is brought about by trauma in normal or rapid deliveries, by congestion or asphyxiation in slow deliveries, or by disease of the child itself. The so-called hemorrhagic disease of the newborn is a much neglected but very important cause of cerebral hemorrhage, occurring in 22 per cent. of the series.

Forceps deliveries, advanced age of the primipara mother and syphilis probably do not play as important a part in the etiology of this condition as was formerly supposed.—H. C. CARPENTER.]

DIAGNOSIS.—In small cerebral hemorrhages the characteristic symptoms are often entirely absent. In the absence of physical findings in the heart or lungs, dyspnea and cyanosis are very suggestive symptoms of hemorrhage. Signs of intracerebral pressure, such as twitching, increased tension at the anterior fontanelle and convulsions help to confirm the diagnosis.

Intrameningeal hemorrhages forming part of the "hemorrhagic disease of the newborn" may be epidural, subdural, or subarachnoid, and are attended with a high mortality during the first few days of life. The congestion attending asphyxia, as well as direct pressure on the skull and overriding of the cranial bones, constitute their exciting cause. Infratentorial hemorrhage and hemorrhage into the lateral ventricles both usually cause almost immediate death from asphyxia. Supratentorial hemorrhage is manifested by initial restlessness with cries of pain, a period of cerebral irritation marked by convulsions, pallor, refusal to nurse, and the cephalic cry, and a terminal period of paralysis in severe cases. Immediate diagnosis is often difficult. Focal irritations and blood-stained spinal fluid are definite signs. Convulsions following thereafter clinch the diagnosis. Evidence that hemorrhage has occurred or progressed is furnished by finding the coagulation time and bleeding time prolonged beyond the normal. A bad prognosis is indicated by deep asphyxia.

In the treatment, human blood should be administered if coagulability is found to be low. Absolute quiet is essential. Chloral hydrate and bromides will prevent crying and check convulsions. Spinal puncture

may be of therapeutic value. **Fontanel puncture** is a more efficient procedure. **Operative intervention** is justifiable in subdural hemorrhage, and should be carried out as soon as symptoms of intracranial pressure have appeared, without waiting for paralysis. E. J. Barnett (Northwest Med., Aug., 1922).

PROGNOSIS.—The collected statistics from various writers establish the mortality as ranging from 35 to 87 per cent. These figures bear, however, on cases that did not receive the benefit of more recent treatment. The generally bad outlook has been converted into a favorable one. Indeed, Welch made the assertion that “**subcutaneous injection of normal human blood-serum** will control 100 per cent. of this type of hemorrhage.” The necessarily fatal cases are those secondary to a profound infection, such as syphilis; or in which there are massive hemorrhages due to ulcers of the stomach or duodenum, or bleeding into the organs themselves, death ensuing by reason of the region involved rather than the hemorrhage.

The statistics of deaths from hemorrhage are much higher in maternity hospitals than in the community at large. This is because the diagnosis of hemorrhage, especially cerebral, is often overlooked outside of well-conducted maternity wards. The family physician should be more alert to the recognition of this condition.

Asphyxia of the infant during birth impairs the clotting power of the blood, rendering the child especially susceptible to both immediate and delayed hemorrhagic lesions. Therapeutic measures should be used promptly. L. A. Wing (Bull. Lying-in Hosp., City of N. Y., Aug., 1923).

TREATMENT.—The formerly advocated treatment with gelatin, epi-

nephryn, etc., has largely given way to one of the methods about to be described, which are dependent upon **blood transfusion, injection of blood-serum, or injection of whole blood directly** into the circulation or under the skin.

Transfusion of whole blood, given early, has not only saved the lives of many infants, but by checking cerebral hemorrhage, has effectively prevented much mental defectiveness. The blood coagulation time of all newborns is taken routinely in some maternity wards, and when coagulation is found delayed, **whole blood** is given **subcutaneously**. This should, at least, be the regular procedure after all difficult labors.

Rodda has demonstrated a simple, effective method of testing the coagulation time. His procedure is to collect a few drops of the infant's blood on a clean watch crystal containing a No. 6 shot; another crystal is inverted as a cover over the first, and the shot is rolled until the blood is coagulated. If clotting does not occur before 10 minutes, the infant should receive a prophylactic injection of whole blood to prevent hemorrhage. The coagulation time is again taken 4 hours later, and if not shortened, another blood injection is given; if this does not accomplish the desired result, a new donor is used for a third injection.

Bleeding surfaces which can be reached may be treated by the usual **surgical means**; but the underlying factor must be controlled at once by that one of the methods given below which is found most practical under the circumstances.

Horse serum, such as is used for the preparation of diphtheria antitoxin, may be used in an emergency,

10 c.c. (2½ drams) being injected. This, however, is not recommended if **whole blood** is available. The **blood from a parent** is preferable to that of a foreign donor. Twenty c.c. (5 drams) should be drawn from a vein of the forearm and injected into the deeper tissues of the back, this being repeated every 4 to 8 hours until the hemorrhages have been controlled.

In cases of severe or protracted hemorrhage, John C. Hirst, 2d, advocates, as the best means both to control bleeding and to make up blood loss, the injection of 50 to 100 c.c. of **whole blood** into the infant's **circulation**. If possible, grouping of the donor's blood with the infant's should be carried out before the injection, in order to find either a donor in the same blood group as the infant, or a No. 4 donor. In an emergency, the blood of either the father or mother may be used without grouping, the chances amounting to over 55 per cent. that the infant's blood will match the blood of either parent.

If the family history shows a definite tendency to hemorrhage the infant should receive treatment as though suffering from hemorrhage. In these instances, as well as in actual moderate or very early bleeding, the mother's arm should be prepared as for Wassermann blood taking, a 10 c.c. syringeful of **blood** withdrawn from the vein, and at once **injected**, before clotting can occur, intramuscularly into the child's buttock or between the shoulder blades. This is followed by **light massage** for a few minutes and repeated at a different situation in 6 hours, up to 4 to 6 injections. **Normal horse serum** or **diphtheria antitoxin** can be similarly used, but only after the anaphylactic test, *i.e.*, injection of 2 or 3 minims of the serum and waiting 10 minutes

for skin reddening, urticaria, etc., to appear, in which event such serum is contraindicated. Horse serum can be repeated every 6 hours for 24 or not exceeding 48 hours. **Hemoplastin**, 2 to 3 c.c. (32 to 48 minims), can be used instead. In severe or protracted bleeding, the best treatment is injection of 50 to 100 c.c. of **whole blood** into the infant's superior longitudinal sinus or the internal saphenous vein at the inner malleolus. In exsanguinated infants a second injection, of 100 c.c., from a fresh syringe, is required, to a total amount of 150 c.c., which need not be repeated. Previous to these injections blood grouping should be carried out if possible. If *syphilis* is responsible, as shown by a positive Wassermann in mother or infant or by clinical signs, 10 grains (0.6 Gm.) of **blue ointment** should be spread daily on waxed paper under the infant's abdominal binder, the site being changed at each application. J. C. Hirst, 2d (Therap. Gaz., Jan., 1923).

For the **intramuscular injection of blood**, the writer collects the blood from the arm of either parent with an ordinary Luer syringe. From 10 to 30 c.c. is injected into the muscle with great pressure, followed by gentle massage for a few minutes to aid diffusion and absorption. In the diaper age, it is perhaps best not to inject into the buttocks for fear of infection. The indications for blood injection are hemorrhage or sepsis of the newborn, jaundice, severe athrepsia, simple anemia, von Jaksch's anemia, and leukemia. A. Hymanson (Arch. of Ped., July, 1925).

In cases in which haste is not so imperative, **human blood-serum** can be readily prepared according to **Welch's method** :—

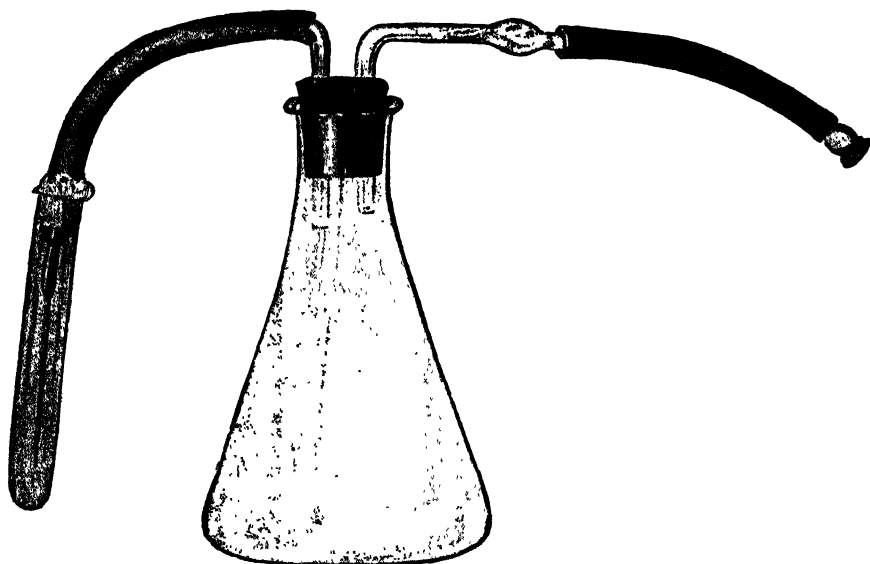
To a heavy glass filter flask of about 400 c.c. (13½ ounces) capacity fit a rubber stopper having 2 perforations. Through one perforation insert a fusiform glass tube, containing a piece of cotton. Through the second

perforation insert a U-shaped glass tube to the outer end of which a needle, caliber No. 19, is attached by means of a piece of soft-rubber tubing. The outer limb of the U-tube, carrying the needle, should then be cotton-plugged into a small test-tube and the entire apparatus sterilized at 150° C. (302° F.), dry heat, for half an hour.

In preparation for withdrawing the blood a tourniquet is placed around

contracted and expressed the serum, which can then be decanted into a sterile flask and placed on ice for use as described. Enough serum will collect in 1 hour for an initial injection, and the beginning of the treatment need not be longer delayed.

In giving the injections it is advisable to use a glass syringe, which can be thoroughly boiled, as the use of chemicals for the sterilization of the instrument might cause some



Flask for collecting blood-serum (Welch's method).

the arm just above the biceps and pressure enough exerted almost to obliterate the radial pulse. After extreme engorgement of the veins has been produced, the needle of the apparatus is inserted into a prominent vein at the cubital space and about 10 ounces (300 c.c.) of blood withdrawn into the flask. The rubber stopper is next withdrawn and a sterile cotton plug inserted into the flask, which is then placed in a slanting position, at room temperature (not on ice), until the coagulum has

alteration of the serum, either neutralizing it or rendering it toxic.

One ounce (30 c.c.) of the serum is given at each injection—twice daily—to moderate bleeders; to those bleeding profusely it should be given 3 times daily or every 4 hours until the bleeding is under control, which is usually within 24 hours. It is best given subcutaneously, very slowly, and with gentle massage over the site of administration until all of the serum injected shall have been taken up by the circulation.

Lindemann's method differs in the respect that **whole blood** is transferred with syringes and special cannulas. If necessary, a large measured quantity can be quickly transferred to the recipient, injection being made directly into a vein. The cannulas only are lined with a film coating of albolene. Dexterity and speed are necessary for success. A relay of syringes, usually of 20-c.c. size, is used, clotting being avoided by not exceeding 10 seconds as the time elapsed between the filling and emptying of each syringe.

Wetterdal, in 2 Stockholm maternities, found records of a 47.4 per cent. mortality in cases receiving only symptomatic treatment, 28.5 per cent. in cases in which **gelatin** was injected, and 14.3 per cent. in cases in which **blood transfusion**, with or without gelatin, was used. Feeding, he states, should be kept up, as it does not seem to aggravate the bleeding, and dehydration should be combated.

Frequent use of **lumbar puncture** in the newborn has been advocated by Sharpe, who, performing punctures in 100 consecutive newborn infants in a hospital service, found free blood within 12 to 48 hours after birth in 9 infants. Five of these came from apparently normal births and appeared normal. In 4 the hemorrhage was of large amount, and 2 died, 1 showing a right ventricular hemorrhage at necropsy, the other a subarachnoid hemorrhage with extensive cerebral edema.

Lumbar puncture necessitates holding the child in such a position as definitely to produce venous congestion in the cranial cavity, which favors further hemorrhage. Considering the small size of the spinal canal, and especially of the posterior for-

amina, together with the richness of the venous plexus and of the blood-supply to the vertebræ, we realize that only the exceptional lumbar puncture can be relied on, and that presence of blood in the spinal fluid withdrawn under these conditions is of extremely doubtful value in the diagnosis of intracranial hemorrhage. As to lumbar puncture as a remedial measure, the objections are that if there is much blood within the canal, its removal may simply effect a renewed hemorrhage, while if the hemorrhage has lasted 24 hours, the damage is already done and puncture will not relieve it. At present, the best treatment for intracranial hemorrhage is **absolute quiet and rest**. C. G. Grulee (Proc. Sect. on Dis. of Childr., Amer. Med. Assoc., 1925).

Lumbar puncture should be carried out in every newborn baby who does not act normally. It should be repeated every 6 to 24 hours until the fluid returns clear and the symptoms subside. W. O. Ott (Tex. State Jour. of Med., Apr., 1926).

EPIDEMIC HEMOGLOBINURIA (Winckel's Disease).

Winckel's disease is a rare and very fatal condition characterized by icterus and the appearance of hemoglobin in the urine.

SYMPTOMS.—These usually appear about the fourth day, and are very severe from the onset. The skin is cyanosed, and jaundice appears.

There is but rarely any elevation of temperature; the pulse and respirations are exceedingly rapid; there are marked restlessness, depression, and a tendency to coma and convulsions. The urine is expelled with some straining, and rather frequently, but in small amounts. It is smoky in character, and on further examination is found to contain hemoglobin, renal elements, granular casts, and blood-corpuscles. No bile is present, and albumin, excepting in traces, is rare.

ETIOLOGY.—Since Winckel described this condition in 1879, conceptions of many of the affections of the newly born have changed. There is little doubt that this condition is the result of an infection, and this is borne out by the fact that it occurs in epidemics, usually in institutions.

PATHOLOGY.—The skin is bronzed, due to the intense icterus. The spleen is enlarged and its pulp intermixed with blood-pigment. Fine punctate hemorrhages are often found in many of the larger organs, especially in the kidneys. The bladder contains the typical smoky urine.

PROGNOSIS.—This is almost invariably fatal, and the babe seldom lives longer than forty-eight hours.

TREATMENT.—The bacteremia is so profound that measures thus far proposed have not succeeded in saving life.

FATTY DEGENERATION OF THE NEWBORN (Buhl's Disease).

This is an exceedingly rare disease, bacteremic in nature, and characterized by parenchymatous inflammation, followed by fatty degeneration, of vital organs, as the liver, heart, and kidneys. The changes in these viscera are not unlike those found in acute yellow atrophy. The disease begins about the fifth or sixth day, probably through an infection of the umbilical stump. Asthenia increases from day to day; the infant becomes exceedingly pale, then jaundiced, and hemorrhages appear in the skin and sometimes in the mucous membranes. Edema, which becomes general, ensues before the end. Death is seldom delayed beyond two weeks.

The treatment is the same as for sepsis, but so far no successful results have been reported.

SEPSIS OF THE NEWBORN.

That the tender infant is very susceptible to infection is recognized, but the effect of infection on infants is so varied that much confusion has resulted from descriptions which do not definitely give the proper place to microorganisms as the etiological factor. The streptococcus, the *B. coli*, and the staphylococcus are the organisms which are most frequently found by cultural methods in the bloodstream.

SYMPTOMS.—The onset is often during the first week of life. Fever is an early manifestation, and usually with an exceedingly high range. The respirations are irregular or labored in type, and diarrhea, with frequent green stools, is almost the rule. Depending upon the type of infection, systemic disturbances may ensue which direct the attention to one of the clinical forms of sepsis, *i.e.*, the symptoms may be mainly meningeal, pulmonic, or gastroenteric.

Icterus is quite commonly seen, and with it may appear a maculopapular eruption, which later assumes pustular characteristics. The infant refuses to nurse and loses weight rapidly, and hemorrhages are apt to occur in any part of the body. Twitching, carpopedal spasms, or other evidences of cerebral irritation ensue. Convulsions occur if the toxic condition does not abate.

ETIOLOGY.—Wherever infants are grouped together in numbers, as in maternity hospitals or foundling asylums, septic cases are apt to occur. This is due to contact infection, infected dressings, or diapers, or to the carrying of organisms by the hands of untrained attendants from patient to patient. During parturition the

infant may be infected through the vaginal discharges, or the umbilical stump may receive the microorganisms from unclean hands or instruments.

As Hamill and Nicholson have pointed out, pathogenic microorganisms are apt to be introduced in the presence of suppurative lesions of the breast. Even in milk from apparently normal breasts microorganisms—mainly the *Staphylococcus aureus* and *albus* and the streptococcus—have been isolated.

Of 224 cases of *impetigo* in the newborn in a hospital outbreak, the first 3 died—a mortality of 1.3 per cent. Two died at 10 days and 2 weeks, respectively, when the lesions were healing. The other death occurred after the infant had been taken home against advice. *Staphylococcus pyogenes aureus* was the predominating organism. No definite source of infection could be determined. Death probably occurs in those children with marked exfoliation and secondary infections. H. S. McCandlish (Amer. Jour. of Obst. and Gyn., Feb., 1925).

Neonatal *pyelitis* occurs periodically and is easily overlooked. The early symptoms are invariably referable to the gastrointestinal tract or central nervous system. It occurs particularly in male infants. Microscopy and culture of the urine of 15 non-thriving newborn infants with gastrointestinal symptoms or cyanosis revealed pus and *B. coli* in 14 instances. When free from complications, the disease usually responded within 6 weeks to diuresis and continued alkalization of the urine. The infection is probably due to pathogenic, enteric *B. coli* which localize by way of the blood stream. L. W. Sauer (Jour. Amer. Med. Assoc., Aug. 1, 1925).

PATHOLOGY.—Since the septic process may invade almost any organ or structure of the body, the lesions are necessarily varied. The organs almost invariably show marked congestion, cloudy swelling, and infiltration

or fatty degeneration. Hemorrhages into the organs are exceedingly common. Lymph-nodes draining the infected tracts are found enlarged. The mucous membrane of the intestinal tract is engorged and thickened; it is not uncommon to find Peyer's patches or the follicles unduly prominent, or various stages of ulceration may occur.

PROGNOSIS.—This should be guardedly given, even in seemingly mild forms. In private practice the outlook is decidedly better than it is in institutions.

TREATMENT.—PROPHYLACTIC.—Pediatrists today recognize that sepsis must be fought with **surgical cleanliness** if infants are to be cared for in numbers. The umbilical cord should always receive most careful attention. Scrupulous care must be taken to **prevent contact infection**. Especially is it important not to permit anyone suffering from an ordinary cold to come in contact with the newborn infant.

Nasopharyngitis in the newborn is all too likely to lead to bronchopneumonia, otitis media and meningitis. One must insist that whoever handles the infant wear a mask if she has the slightest coryza or pharyngeal irritation, and that visitors keep away from the baby. In the newborn the external auditory canal is narrow and the drum lies obliquely. This renders examination difficult. If, however, one finds high temperature, with convulsions, rapid respiration, or crying together with a nasopharyngitis, one is justified in incising the ear drum if it is at all swollen. R. Taylor (Jour. Iowa Med. Soc., May, 1924).

An incidence of 19.4 per cent. of *pneumonia* was noted in 500 necropsies on viable and non-viable, newborn and stillborn infants. The cases

were listed in 4 groups: (1) Antenatal infection, with antenatal or intranatal death, 30 cases; (2) probable antenatal or intrapartum infection; death usually within 3 days after birth, 38 cases; (3) pneumonia with hyaline membrane (type of asphyxia neonatorum), 8 cases; (4) postnatal infection, 21 cases. W. C. Johnson and J. R. Meyer (Amer. Jour. of Obst. and Gyn., Feb., 1925).

In institutions, if the infants had an abundance of sunlight and fresh air, if they could be daily removed to freshly aired pavilions, and could be placed in separate cubicles to sleep, then, with cleanly attendants, the occurrence of sepsis would be markedly reduced.

GENERAL.—The treatment of the infection itself is mainly symptomatic unless it is possible to prepare a **vaccine**, which should be tried. Localized abscesses must be opened and drained. Forced feeding, injection of saline solution, and cardiac stimulation with whisky are indicated. A measure of success may be had, even in seemingly hopeless cases, by injections of homologous blood-serum.

GODFREY R. PISEK,

New York,

AND

HOWARD CHILDS CARPENTER,

Philadelphia.

NICKEL (Nicolum).—Metallic nickel is not used in medicine, but several of the salts (bromide, carbonate, hydrochloride, and sulphate) have been experimented with; none is official.

Nicoli bromidum (nickel bromide) occurs as green, deliquescent crystals soluble in alcohol and water. Its physiological action is analogous to that of sodium bromide, but it is more irritant to the stomach. The dose is 10 grains (0.60 Gm.).

Nicoli sulphas (nickel sulphate) occurs as a green crystalline powder or prisms, which effloresce on exposure. It

is soluble in 3 parts of water, insoluble in alcohol, has a sweetish, styptic taste, and has been credited with tonic, sedative, and soporific properties. The dose is $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.) 3 times daily.

Kolipinski found the sulphate useful as an antiseptic and bactericide, of especial value in the parasitic skin diseases, applied in a 1 or 2 per cent. aqueous solution. He also claimed benefit from its use in doses of 1 grain (0.06 Gm.) after meals, in chorea, chronic neuralgia of the face, tic douloureux, migraine, chronic enteritis, epilepsy, emotional and psychic weakness, and neurasthenia. W.

NITRIC ACID.—*Acidum nitricum*, U. S. P. (hydrogen nitrate, or aqua fortis), is a transparent, colorless (or of slightly yellow tinge), fuming (white or grayish fumes), suffocating, and caustic liquid, strongly acid and volatile with heat. It should have a specific gravity of about 1.40 (42° Baumé). It is miscible in all proportions with water, and when added to alcohol decomposes it with violence. It should be kept in a dark-amber, glass-stoppered bottle. It is the strongest of the mineral acids.

PREPARATIONS AND DOSES.

Acidum nitricum, U. S. P. (67 to 69 per cent. absolute nitric acid).

Formerly official was:—

Acidum nitricum dilutum, U. S. P. VIII (nitric acid, 10 per cent.). Dose, 5 to 30 minims (0.3 to 2 c.c.).

Semi-official are or were:—

Acidum nitrohydrochloricum, N. F. (nitric acid, 18 per cent.; hydrochloric acid, 82 per cent., by volume). Dose 2 to 5 minims (0.12 to 0.3 c.c.).

Acidum nitrohydrochloricum dilutum, N. F. (nitric acid, 4 per cent.; hydrochloric acid, 18.2 per cent., by volume). Dose, 10 to 20 minims (0.6 to 1.2 c.c.).

Mistura camphoræ acida, N. F. IV (Hope's mixture). Nitric acid, 30 minims (1.75 c.c.); tincture of opium, 20 minims (1.2 c.c.); camphor-water, to make 25 drams (100 c.c.). Dose, 2 drams (8 c.c.).

PHYSIOLOGICAL ACTION.—In weak solution nitric acid slightly stimulates the tissues, but applied pure it destroys them. Internally it may only be used greatly diluted. Addition of nitric acid

where gastric acidity is deficient may be expected to subserve those functions normally assumed by the stomach acid, *viz.*, digestion of proteins and connective tissue, control of the pyloric sphincter (probably indirectly through neutralization of alkali regurgitant through the pylorus), and antiseptis. The dilute mineral acids have also been credited with the power slightly to increase the flow of pancreatic juice and bile and the gall-bladder contractions.

Upon absorption, and by conversion into nitrates, nitric acid increases the acidity of the urine, incidentally tending to irritate the urinary mucosa if already inflamed. It increases the ammonia in the urine at the expense of the urea.

POISONING BY NITRIC ACID.—

The symptoms of poisoning by nitric acid in concentrated form are those of an acute and violent inflammation of the digestive tract induced by the ingestion of a caustic irritant. They vary in severity and rapidity of development according to the strength and amount of the acid swallowed. The fact that when nitric acid comes in contact with organic matter it imparts to it a yellow color or stain, not easily removed, aids us in differentiating the traces of nitric acid from those of sulphuric (black eschar) or hydrochloric (white eschar) acid. Thus, we may look for yellow stains on the skin, in the mouth, and perhaps on the clothing. Great pain will be present throughout the entire digestive tract, associated with vomiting of a dark matter, resembling coffee-grounds (altered blood), and occasionally portions of mucous membrane; a feeble pulse, clammy skin, and profuse bloody salivation. Renal irritation may be severe and the urine and feces may contain blood more or less altered. Death may occur either from the gastrointestinal inflammation or from collapse. If recovery take place the patient may suffer from stricture of esophagus, stomach, or bowels, or from more or less destruction of the peptic tubules.

Treatment of Nitric Acid Poisoning.—

There are four indications to be met: (1) to neutralize the acid through the use of alkaline solutions,—**chalk, magnesia, sodium or potassium carbonates, scrapings from whitewash or plastered**

walls, or even soapsuds; (2) to protect mechanically the corroded and inflamed tissues, through the use of **white of egg, oils, and mucilaginous drinks (flaxseed-tea, barley-water, etc.);** (3) to relieve the pain, through the use of **opium;** (4) to counteract the depression of the vital powers, through the application of **external heat, the use of stimulating and nutrient enemata, and venous injections of ammonia.** If pure acid in any considerable amount has been ingested, favorable results must not be looked for. The smallest quantity of nitric acid that has produced death was 2 drachms. Death ensued in two hours.

Fatal accidents occasionally result from **inhaling the fumes** of nitric acid, which set up a bronchopneumonia, which demands **stimulation, the use of oxygen** when indicated by the cyanosis and symptoms of collapse, **atropine** for the edematous exudation, vigorous **counterirritation, leeches, with elimination and supportive measures.** After recovery **work** should be **forbidden, all exposure avoided, and residence** should be in a warm, equable climate. The infection of tuberculosis should be **guarded against.**

THERAPEUTICS.—When nitric acid is taken internally it should be freely diluted and be taken through a glass tube to prevent its corrosive action on the teeth. When taken continuously for too long a period it may affect the gums like mercury (salivation and spongy gums, probably due to local action), and this should be an indication for suspending its use.

Internal Uses.—Nitric acid has been found to benefit patients suffering from **oxaluria**, and from **dyspepsia** with phosphatic urine. Its use has also been advised in **lithemia.** In **stomatitis** with the presence of small ulcers in the mouth and over the tongue the internal administration of nitric acid in small doses is followed by good results, especially if each ulcer be touched with a 60-grain solution of nitrate of silver. **Summer and colliquative diarrhea** are favorably influenced by the internal administration of nitric acid. Hope's camphor mixture (*Mistura Camphoræ Acida, N. F.*) yields good results in dysentery. In **chronic diseases of**

the liver nitric acid is useful, but nitro-hydrochloric acid is better, especially in **mucous duodenitis** and **catarrh of the gall-ducts** and **malarial jaundice**. **Intestinal indigestion** associated with **diarrhea** yields kindly to nitric acid; when diarrhea is absent hydrochloric acid is to be preferred.

Chronic bronchitis and **hoarseness** produced by singing are said to be relieved by 10-minim (0.65 c.c.) doses of dilute nitric acid (Bartholow). In **whooping-cough** nitric acid is beneficial after the subsidence of the catarrhal stage, though some claim that it shortens the duration of the disease. Hammond, Bailey, and others have used nitric acid with success in the treatment of **intermittent fever**, giving it in full doses every four or six hours. It is also of great service in relieving **hepatic congestion**, after the paroxysm has been arrested by quinine. It is best given combined with the bitters.

Local Uses.—Nitric acid used locally is caustic, astringent, or stimulant according as it is used pure or diluted. Pure nitric acid is one of the most efficient and most controllable escharotics at our command. The area of action may be limited by the previous application of a ring of oil or of ointment, and the depth of action by the subsequent application of an alkaline solution or of soapy water. It may be applied as a caustic to **phagedenic ulcers**, **chancroids**, **cancrum oris**, and also **hospital gangrene**. **Warts** and **condylomatous growths** yield to its action. On **inoperative cancerous growth** it may be used as a palliative. **Free-bleeding hemorrhoids** may be relieved by touching the tumors lightly with the pure acid, through a speculum, and mopping the parts with oil liberally after the acid application.

The application of fuming nitric acid is the most effectual means of destroying the "virus" of **rabies** in wounds, if possible before it has germinated in the wound. This does not do away with the necessity of the Pasteur treatment, but only paves the way for it. Incidentally, we remark, that wounds made by rabid animals should not be sutured; they should be allowed to bleed.

Its application may be rendered painless by allowing as much cocaine as the quan-

tity of acid used will take up, to dissolve in it.

In gynecology pure nitric acid may be applied to the cervix or endometrium for the cure of **cervical endometritis**, **granular endometrium** or of small **fibroid tumors**. It is also used to arrest the **hemorrhage** from the mucous membrane which occurs after the operative removal of polypi or small tumors.

In rhinology nitric acid may be used, applied in a fine wire probe lightly wrapped with cotton, to remove **hypertrophy** of the erectile tissues covering the middle turbinated bones. A previous application of a 4 per cent. solution of cocaine renders the application painless. The acid should be applied lightly and only over the space covered by the probe. It may be repeated, if required, after the slough has separated and the parts healed.

The astringent action of nitric acid (1:500 parts) is appreciated when it is used to irrigate the bladder in cases of **chronic cystitis**, and as well when there are **phosphatic deposits in the bladder**. The solution should be slightly warmed before using.

Nitric acid as a stimulant (2 per cent. solution) is useful when applied to **unhealthy ulcerations** and to **irritated and bleeding hemorrhoids**.

Incidentally we may note the use of nitric acid as a test for detecting the presence of albumin in the urine; the methods for applying it for this purpose are given in full under **ALBUMINURIA** in volume i. S.

NITRITES.—The salts of nitrous acid [HNO_2] are termed nitrites. Those used in medicine, either as such or in solution as an officially recognized preparation, are sodium nitrite, ethyl nitrite (in sweet spirit of niter), and amyl nitrite. The last two of these, containing organic radicles, are properly termed esters of nitrous acid. With the nitrites may also be appropriately considered certain compounds which, though introduced in the body as nitrates, are

decomposed into nitrites before exerting their effects, *viz.*, nitroglycerin (official in spirit of glyceryl trinitrate), and the two unofficial drugs, erythrol tetranitrate and manitol hexanitrate. Potassium nitrate, which liberates nitrites upon combustion, may likewise be included.

PREPARATIONS AND DOSE.

—The preparations of the nitrite group are as follows:—

Amylis nitris, U. S. P. (amyl nitrite; isoamyl nitrite) $[C_5H_{11}NO_2]$, occurring as a yellowish, transparent, very diffusive, unstable liquid of specific gravity approximating 0.870, with a penetrating ethereal, fruity odor, and a burning, aromatic taste. The official preparation is required to yield not less than 80 per cent. of pure amyl nitrite when assayed by a specially prescribed process. It is almost insoluble in water, but is miscible with alcohol, ether, and chloroform. It boils at approximately 208.4° F. (98° C.), and is inflammable. It decomposes gradually on exposure to light or air. Dose, by inhalation, 1 to 5 minims (0.06 to 0.3 c.c.); internally, doses of 3 to 8 minims (0.2 to 0.5 c.c.) have been used.

Sodii nitris, U. S. P. (sodium nitrite) $[NaNO_2]$, occurring in colorless crystals or in white fused masses (sticks), odorless, and with a mild, saline taste. The salt is officially required to be not less than 95 per cent. pure. It is soluble in about 1.5 parts of water, and slightly soluble in alcohol. Upon exposure to the air it deliquesces and gradually becomes oxidized to sodium nitrate. It is non-volatile and non-explosive. Dose, 1 to 3 grains (0.06 to 0.2 Gm.).

Spiritus aethyilis nitritis, U. S. P. (spirit of ethyl nitrite; sweet spirit

of niter), made essentially by the gradual addition of a solution of sodium nitrite to previously diluted sulphuric acid, washing the ethyl nitrite $[C_2H_5NO_2]$ separated from the mixture, and mixing it with twenty-two times its weight of alcohol. The product, when specially assayed, is required to contain 3.5 to 4.5 per cent. of pure ethyl nitrite, and is a clear, volatile, inflammable, slightly greenish or yellowish fluid, with a fragrant odor and burning taste. Upon prolonged keeping, or free exposure to air and light, it becomes acid in reaction. Dose, 15 minims (1 c.c.) to 4 fluidrams (15 c.c.); official average dose, 30 minims (2 c.c.).

Spiritus glycerylis nitratis, U. S. P. (spirit of nitroglycerin; spirit of glonoin; spirit of glyceryl trinitrate), an alcoholic solution containing 1 to 1.1 per cent. by weight of glyceryl trinitrate. It occurs as a clear, colorless fluid, with the odor and taste of alcohol. It is dangerously explosive if the alcohol be partly or wholly lost by evaporation. Dose, 1 to 2 minims (0.06 to 0.12 c.c.).

Potassii nitras, U. S. P. (potassium nitrate; niter; saltpeter) $[KNO_3]$, occurring in colorless crystals or powder, with a saline, pungent taste, soluble in 2.8 parts of water, but very sparingly in alcohol. It is used in solution to saturate filter-paper, stramonium or tobacco leaves to be employed in bronchial asthma. The nitrites produced through combustion of these preparations are inhaled and relax the contracted bronchioles.

Pilulæ glycerylis nitratis, N. F. IV (pills of nitroglycerin or glonoin), each containing 1 minim (0.065 c.c.) of spirit of nitroglycerin, with althea and confection of rose. Dose, 1 pill.

Unofficial compounds are:

Nitroglycerin (glyceryl trinitrate, trinitrin, glonoin) $[C_3H_5(NO_3)_3]$, a volatile, explosive fluid, contained in the spirit of glyceryl trinitrate, and also commonly in the form of hypodermic tablets or tablet triturates. Its volatility renders these latter preparations unreliable. Strong alkalies remove its explosive power by decomposing it. Dose, $\frac{1}{100}$ minim (0.0006 c.c.).

Erythrol tetranitrate (tetranitrol) $[C_4H_6(NO_3)_4]$, a slightly volatile solid, highly explosive, practically insoluble in water, and marketed usually in tablets, which should preferably be coated to delay deterioration. Dose, $\frac{1}{2}$ to 1 grain (0.03 to 0.06 Gm.). (See also ERYTHROL TETRANITRATE.)

Mannitol hexanitrate $[C_6H_8(NO_3)_6]$, a solid compound. Dose, 1 grain (0.6 Gm.).

Amyl nitrite, in glass pearls, keeps well if not exposed to the light. A change in color makes practically no difference in activity.

Tablets of nitroglycerin may retain their activity for a year or more; yet comparatively fresh tablets are often inert. A 1 per cent. solution keeps fairly well. If diluted, it may weaken.

Solutions of sodium nitrite deteriorate rapidly; a solution should not be used which is over a week old.

Chocolate-coated tablets of erythrol tetranitrate, even after being kept for one year, retain their full activity. G. B. Wallace and A. I. Ringer (Jour. Amer. Med. Assoc., Nov. 13, 1909).

PHYSIOLOGICAL ACTION.—

Circulatory system.—The chief action of the nitrites is upon the circulation, and in this field, in turn, their direct influence is exerted upon the blood-vessels rather than the heart itself. The muscular tissue in the vessel

walls is powerfully depressed by the nitrites, with the result that these walls yield to the pressure of blood within, which pressure, since the total amount of fluid in the cardiovascular apparatus undergoes no simultaneous increase, recedes in consequence. That the effect is not exerted through an action on the vasomotor centers is indicated by the fact that the pulmonary arteries, which are not considered to possess vasomotor nerves, are dilated by the nitrites like other arteries, and conclusively shown by the fact that if, in an experiment, a nitrite be injected so that it will reach the medullary centers but cannot enter the general circulation, the characteristic fall of blood-pressure will not take place. If a nitrite be added to fluid passing through the vessels of an isolated organ or limb, the outflow from these vessels is markedly increased, showing the direct vasodilator effect of the drug. The vessels of the splanchnic area are the most strongly affected by nitrites, but a powerful action is also exerted in the arteries of the brain, lungs, heart, and limbs, and superficially in the neck and head, the skin of which becomes flushed. The veins have been shown to be influenced like the arteries.

The action of nitroglycerin was manifested in 16 out of 23 cases by subsidence of pressure in the brachial artery, while at the same time the pressure rose in the arteries in the fingers. The drug has an elective action on the peripheral portion of the circulation. As it dilates the arterioles, the work of the heart is lightened. If the heart is very weak and close to exhaustion the blood-pressure in the finger arteries rises very little if at all. The power of

dilatation of the peripheral vessels determines the amount of action of nitroglycerin. Dmitrenko (Zeit. f. klin. Med., lxxviii, Nu. 5-6, 1909).

All the nitrites produce prompt relaxation of rings from the coronaries of the ox and pig, placed in warm oxygenated Locke's solution. This dilator action of the nitrites tends to explain their favorable action in angina pectoris. C. Voegtlin and D. I. Macht (Jour. of Pharm. and Exper. Therap., Sept., 1913).

Experiments in dogs showing that nitroglycerin in small doses often produces a rise of pulmonary pressure due to increased cardiac output from acceleration and increased venous return. It reduces a high pulmonary pressure apparently by dilating the pulmonary arteries. It does not stimulate excised pulmonary arteries of dogs. Thus, its action is the same upon pulmonary and systemic arteries, although less marked upon the pulmonary vessels. The action upon pulmonary pressure is, however, often counterbalanced or overbalanced by the secondary effects of its action upon the systemic vessels. G. R. Love and H. McGuigan (Jour. of Lab. and Clin. Med., Aug., 1925).

During the drop in blood-pressure produced by a nitrite the heart rate increases—by as much as 20 or 30 beats per minute after amyl nitrite. This has been shown not to be due to a stimulating effect on the heart, and is considered the result either of a reflex depression of the vagus (such a reflex action normally follows a fall in blood-pressure, however caused), or of a direct depression of the vagus centers by the drug. In old persons, whose hearts are comparatively free from vagus control, the pulse rate does not become accelerated after amyl nitrite inhalation as it does in the young (Hewlett). Sollmann showed that if the nitrite is confined to the cerebral circulation,

an increase in the heart rate occurs in spite of the fact that the general arterial pressure is not lowered, while if the drug is confined to the general and excluded from the cerebral circulation, a fall in pressure takes place without any consequent acceleration of the heart. The view formerly held that nitrites, in particular nitroglycerin, stimulate the heart-muscle, has been proven, at least in large degree, erroneous, by experiments. In large amounts the nitrites directly depress the heart muscle.

In *rapidity and duration of action* the different nitrites vary to a marked extent. Amyl nitrite, inhaled, causes the blood-pressure to drop within a few seconds by from 20 to as much as 70 millimeters of mercury; the pressure then rises almost to the previous level in two to five minutes, and has wholly returned to it in fifteen to twenty minutes. Nitroglycerin is promptly absorbed, whether given hypodermically or by mouth, but the greatest depression of blood-pressure is produced only in five to fifteen minutes. The effect usually passes off in from one-half to one hour, though in general arteriosclerosis Bastedo has seen it last several hours. Sodium nitrite comes next in the list, pronounced effects from it (when unweakened by exposure to air) beginning in ten to thirty minutes after the drug has been taken by mouth, and persisting for one to two hours. In the case of erythrol tetranitrate and mannitol hexanitrate the action begins somewhat later than with sodium nitrite, but continues for two to five hours. Ethyl nitrite is a very rapidly acting drug, like amyl nitrite, but as it is customarily taken by mouth, the char-

AVERAGE BLOOD-PRESSURE RESULTS IN NORMAL PERSONS.

Drug.	Beginning action. min.	-Time of- Maximum effect. min.	Duration of action. min.	Maximum extent of action. mm. Hg.	%
Amyl nitrite, 3 min. (0.20 c.c.)..	1	3	7	15	11
Nitroglycerin, 1½ min. (0.10 c.c.), 1 per cent. sol.	2	8	30	15	11
Sodium nitrite, 1 gr. (0.06 Gm.).	10	25	60	14	13
Erythrol tetranitrate, ½ gr. (0.03 Gm.)	15	32	120-240	16	14

AVERAGE BLOOD-PRESSURE RESULTS IN PATIENTS WITH ARTERIOSCLEROSIS.

Drug.	action. min.	ime of- aximum effect. min.	Duration of action. min.	Maximum extent of action. mm. Hg.	%
Nitroglycerin, ⅓ gr. (0.002 Gm.)	2	8	35	32	17
Sodium nitrite, 2 gr. (0.13 Gm.).	15	45	120	53	25
Erythrol tetranitrate, 2 gr. (0.13 Gm.)	30	60	180	60	30

acteristically prompt action of amyl nitrite, used by inhalation, is not obtained from it.

Report of a comparative study of the nitrite group in normal individuals and hospital patients. Amyl nitrite was given by inhalation; nitroglycerin, sodium nitrite, and erythrol tetranitrate, by mouth.

With amyl nitrite the authors not infrequently saw a rise instead of a fall of pressure. This occurred if the dose was small, and means a marked capability of the vascular system to retain its equilibrium.

In normal individuals headache is especially severe after erythrol tetranitrate, and may last for many hours after the pressure has returned to its original level. Headache is rarely induced by these drugs if the beginning pressure is abnormally high; in fact, an existing headache not infrequently disappears as the pressure falls.

One patient was given ⅓ grain (0.008 Gm.) nitroglycerin. The pressure dropped from 210 mm. to 60 mm. in ten minutes,—a fall of 150 mm. Hg, or 71 per cent. Four minutes later it was up to 168 mm., and within fifty minutes the pressure was back to its original point. The only symptom was faintness of a few

minutes' duration. To another patient 6 grains (0.4 Gm.) sodium nitrite were given. The pressure fell from 210 to 100 mm. Hg, a fall of 52 per cent. The fall in pressure is rather directly proportional to the dose taken. Only in cases in which the splanchnic vessels are no longer capable of dilatation will a fall not occur. G. B. Wallace and A. I. Ringer (Jour. Amer. Med. Assoc., Nov. 13, 1909).

Nervous System.—No direct action on nervous tissue is exerted by the nitrites, but the marked vasodilatation in the cerebral vessels, in conjunction with the fall in blood-pressure, may lead to headache, dizziness, faintness, blurring of vision, and even, after large doses, convulsive manifestations. Initial stimulation of the medullary centers through irritation of the nasal mucous membrane may result from amyl nitrite inhalation, a temporary rise in blood-pressure and inhibitory slowing of the heart therefore taking place. Nerve-endings, *e.g.*, those of the vagus or of the motor nerves to striated muscle, are apparently uninfluenced by the nitrites.

Respiration.—The breathing is not infrequently rendered deeper and more frequent by the nitrites, the respiratory centers seemingly stimulated. In the case of amyl nitrite, momentary arrest of respiration may precede, owing to irritant impulses transmitted to the respiratory centers from the nasal mucosa.

Muscles.—A relatively important effect of the nitrites is that of depressing the involuntary muscle-tissue in the bronchial tubes. Though not as pronounced as the effect on the vascular musculature, this action is sufficiently powerful to be of utility in bronchial asthma. A possible muscle-relaxing effect of the nitrites in spasm of the bile-duct or ureter is also recognized.

Kidneys.—The effect of the nitrites upon urinary excretion is inconstant, as several factors may be simultaneously operative. A fall in general blood-pressure in itself tends to reduce the urinary output. On the other hand, if a nitrite be given when the renal vessels are too greatly narrowed to permit of a maximum urinary output, their effect in dilating these vessels may improve the renal function, in spite of the reduction in general blood-pressure. The nitrites are thus, at certain times, capable of producing a distinct diuresis.

Temperature.—This may be somewhat lowered, because of the peripheral vasodilatation and consequent increase in heat loss.

Blood.—Taken into the system in very large amounts, or placed in contact with blood in a test-tube, the nitrites cause the blood to assume a more or less pronounced chocolate color, owing to alteration of some of

the hemoglobin into methemoglobin and nitric oxide hemoglobin. The oxygen-carrying power of the blood is thus for a time reduced, though this effect is never sufficient, even after decidedly large therapeutic doses, to cause any serious symptoms. In animal experiments, on the other hand, it has been found possible actually to produce death through excessive alteration of the blood brought on by copious administration of the nitrites.

Absorption and Elimination.—The relative rapidity of absorption of the nitrites has already been considered. The changes undergone by the drugs in the body remain to be discussed. Amyl nitrite, after absorption, does not continue to circulate as such, but is soon decomposed, with formation, first, of nitrites of the alkalies; then, of a certain proportion of alkali nitrates, produced from the nitrites by oxidation. The urine contains a portion of these nitrites, while the breath may contain an unoxidized residuum of the amyl constituent of the original amyl nitrite.

Sodium nitrite, taken by the mouth, is in part decomposed by the hydrochloric acid of the gastric juice, nitrous acid being liberated. This acid, in turn, is itself broken up with liberation of gases which may lead to eructations and irritation of the alimentary tract. Most of the sodium nitrite, however, enters the blood unchanged, part of it, as in the case of amyl nitrite, being then oxidized to nitrates, which later appear in the urine. Amyl nitrite, if taken by mouth, is decomposed in the stomach with even greater readiness than sodium nitrite, and for this reason acts much less strongly than when

inhaled. Subcutaneous injection is also an unfavorable route for the administration of amyl nitrite, the effect being delayed and feeble.

Nitroglycerin is not broken down by the gastric juice, but upon entering the circulation is, for the most part, promptly split up into nitrites, nitrates, and glycerin, the former immediately initiating, and thereafter continuing for some time, the typical nitrite action. The behavior of erythrol tetranitrate and mannitol hexanitrate in the system is, as far as known, similar to that of nitroglycerin.

Nitroglycerin in fluid form acts more strongly than in tablets. Clinical tests showed that the action was strongest upon application about the tongue or irrigation of the mouth with a dilute solution. Little or no effect followed its introduction into the stomach or duodenum. Its rapidity of action is probably due to its great solubility in lipoids, as stressed by Mendel. Further, its transformation into a nitrite seems to be furthered by the ferments found in the alkaline mouth secretion. For an especially rapid action, oral use of 8 drops of the 1 per cent. alcoholic solution in 15 c.c. ($\frac{1}{2}$ ounce) of water, without swallowing, is indicated. Grossmann and Sandor (Klin. Woch., Oct. 1, 1923).

UNTOWARD EFFECTS AND POISONING.—Overdoses of the nitrites cause headache, at times with tinnitus and dizziness. After distinctly toxic amounts, there are likely to occur, in addition, such effects as cardiac palpitation with a rapid full pulse, markedly flushed face, throbbing in the head, a sense of peripheral heat, and rapid respiration; also, occasionally, xanthopsia (yellow vision). Vomiting and diarrhea are likewise possible symptoms. Some mental confusion may be pres-

ent, and eventually motor weakness, loss of reflexes, together with stupor, supervene. The heart action becomes slow, the respiration shallow and frequently irregular, and cyanosis appears. Convulsive movements may be noted. Death takes place by respiratory failure in experimental animals. It is rare in man.

Some individuals have been observed to respond very markedly to small amounts of the nitrites, falling into a syncope, with slowing of the heart. Inhalation of 5 minims of amyl nitrite has been known to cause fainting. Other patients, on the other hand, show an unusual tolerance to these drugs. In one case, recorded by Stewart, 20 grains (1.25 Gm.) of nitroglycerin taken in one day exerted but little action.

Continued severe headache is said to be most common after the use of nitroglycerin and erythrol tetranitrate. Methemoglobinuria and other manifestations of nitrite poisoning have followed the administration by mouth or rectum, or injection into sinuses, for radiographic or therapeutic purposes, of bismuth subnitrate.

Report of cases of poisoning met with among workmen who were accustomed to the daily handling of nitroglycerin, some of which were fatal, and all productive of serious symptoms, such as headache, vomiting, jaundice, and optic atrophy. The symptoms are quite varied. It is hard to detect the presence of the poison in the body chemically on account of its volatile character, and, with the exception of the changes in the blood, which can be made out with certainty only with the spectro-scope, there are practically no organic changes. For treatment of the acute symptoms, **fresh air** and **oxygen inhalations**, if necessary, are indicated. R. R. Pirrie (Practitioner, Feb., 1912).

Treatment of Poisoning.—If a nitrite has been taken internally in toxic amount, the **stomach** should be **evacuated** by means of the **stomach-tube** or an **emetic**. **Strychnine**, **epinephrin**, **ergotin**, **digitalis**, and **cocaine** are suitable physiological antidotes for hypodermic use. In a case reported by Schilling, subcutaneous injection of 16 minims (1 c.c.) of a 5 per cent. solution of **cocaine** led to subsidence of the worst symptoms of the poisoning in a few minutes, and their complete disappearance in a quarter of an hour. The **recumbent position** is advisable, to ease the work of the heart working at a mechanical disadvantage. **Cold applications** may be made to the **head**. An abundance of **fresh air** should be supplied, and **artificial respiration** instituted when the occasion presents.

In poisoning from nitrous gases, *e.g.*, from sawdust being strewn on spilt nitric acid, the main symptoms are in the throat and lungs at first; as these subside in the course of a few weeks, extreme debility, emaciation and nervous symptoms follow and are apt to be permanent. Out of 20 firemen who were seriously poisoned by fumes during the burning of a chemical works, 11 were permanently incapacitated and 1 died. No means of effectual treatment are known; **heart tonics** may be needed, and diluted **lime-water** or other **alkaline water** have been recommended, as also **inhalations of oxygen**, **ammonia**, **sodium bicarbonate spray**, or **venesection** plus **saline infusion**. Some recommend from 3 to 5 drops of **chloroform** in a glass of water taken every ten minutes, until the maximal dose of 1.5 Gm. (23 grains) has been taken in the course of one or two hours. Tetzner (Med. Klinik, April 26, 1914).

THERAPEUTIC USES.—The chief uses of the nitrites is as direct

depressants to involuntary muscle-tissue, especially that of the blood-vessels.

In **chronic nephritis with high arterial tension** the nitrites are frequently used to reduce vascular tone and ease the work of the heart. Although it is not regarded advisable to lower the blood-pressure to normal in these cases, certain organs apparently requiring the greater supply of blood which the high pressure affords, the nitrites are likely to prove beneficial, at least for a time, by avoiding excessively high pressures which tend to induce such symptoms as headache, flushes, tinnitus, dyspnea, etc. Limitation of the nitrogenous intake and maintenance of free action of the skin and bowels are, of course, not to be neglected as remedial measures.

Too readily acquired tolerance to nitroglycerin is not rare. In 1 case 20 minims (1.25 c.c.) of pure nitroglycerin were taken daily. The patient had not been encouraged to increase the dose beyond an amount sufficient to produce more than a slight feeling of fullness in the head. When it is desired to employ this drug for a considerable period, for its effects on blood-pressure, the intervals between doses should be comparatively short—never less than four times daily. If enough is always taken to produce a marked immediate result, such as flushing and slight headache, tolerance is soon acquired. When a rather rapid increase seems necessary in order to maintain a constant effect, an important point is temporarily to discontinue the drug for two or more days, at intervals of two or three weeks. On its resumption, a much smaller initial dose will be required than that last taken. The author rarely exceeds a dose of 10 drops of the 1 per cent. solution, and when for the initial dose of 1 drop tolerance to the larger dose is apparent, the drug

is temporarily discontinued. It is important simultaneously to restrict the nitrogenous intake, and occasionally to use a mercurial purge, or, more frequently, salines. Aconite may often be substituted for nitroglycerin with advantage. D. D. Stewart (Jour. Amer. Med. Assoc. May 27, 1905).

The nitrites have no permanent influence on habitual **hypertension** and should not be used systematically for this purpose, as they would thus lose their power when needed at a critical moment. Spirit of nitrous ether is the only one of the group to which the above does not apply; this drug is more of a general sedative for the circulatory system than a reducer of tension, and it does not contraindicate the use of the other preparations at need. The writer advocates it in doses of 2 to 4 Gm. (30 to 60 minims) a day, in divided doses, kept up for a long time. But when occasionally prompt action is necessary the organic nitrites must be called on. Nitroglycerin is regarded by the writer as the one remedy for **angina pectoris** and **paroxysmal edematous dyspnea** in persons with **arterial hypertension**. H. Vaquez (Arch. des mal. du Cœur, des Vaisseaux et du Sang, Jan., 1908).

In health amyl nitrite relaxes the arteries with a very slight drop in the diastolic blood-pressure. The blood-pressure returns at once to normal on its removal. In **arteriosclerosis** the diastolic blood-pressure drops considerably, although the heart action may be stronger. On removal of the drug the blood-pressure does not return to its former height until after half an hour. The writer has the patients inhale 10 drops of amyl nitrite at once, and has never witnessed any threatening symptoms from it in several hundred experiments on healthy subjects. He has also found it effectual in the treatment of **tuberculous hemoptysis**. C. v. Rzentkowski (Zeitsch. f. klin. Med., Bd. lxxviii, Nu. 1-2, 1909).

Nitrites are valuable in **psychoses** due to **paroxysmal hypertension**, probably attended with cerebral vasoconstriction. In a case of marked hypertension in which a convulsive attack had already occurred, there developed, through auditory hallucinations, an acute attack with delusions of persecution leading to attempted suicide. At this juncture, inhalation of a pearl of amyl nitrite led to cessation of the attack, recollection of which was wholly lost. J. Meyer (Revue méd. univers., Sept., 1926).

In **angina pectoris** amyl nitrite is administered by inhalation, in doses of 2 to 5 minims (0.12 to 0.3 c.c.), ostensibly to relax the coronaries. If the view be accepted that the seat of origin of the pain in **angina pectoris** is the aorta, which is dilated through a temporary increase in cardiac activity, and presses upon the surrounding nerve-plexuses, the drug presumably relieves the pain by reducing the pressure in the aorta through dilatation of the peripheral vessels. Murrel has advocated the use of nitroglycerin in **angina pectoris**; to favor rapid absorption of the drug he administers it in the following mixture:—

R *Spiritus glycerylis nitratis*,

Spiritus chloroformi, āā f3ss (2 c.c.).

Tinctura capsici f3j (4 c.c.).

Aqua menthae piperita,

q. s. ad f3j (30 c.c.).

M. Sig.: One dram (4 c.c.) every four hours, with an extra dose immediately at the onset of an attack.

In certain cases of valvular heart disease, *e.g.*, in **aortic insufficiency** with **excessive hypertrophy** and severe frontal headache, sodium nitrite or nitroglycerin may at times be employed with advantage to reduce the resistance offered to the heart in the vascular system. In **cardiac dyspnea**

the nitrites may prove of value; care should be taken not to exceed moderate doses, however, where fatty disease of the heart is suspected. Parker points out that $\frac{1}{200}$ grain (0.0003 Gm.) of nitroglycerin is often sufficient to relieve **cardiac asthma**; in fact, success from doses as small as $\frac{1}{1000}$ grain (0.00006 Gm.) has been reported.

Some of the cases in which nitroglycerin has proved very successful are: (1) **Cardiac irritability and palpitation** due to tobacco; (2) **double aortic lesions** complicated by intense paroxysms of **angina pectoris**; (3) **aortic stenosis** with weak heart and severe breast pain; (4) simple **cardiac palpitations of neurotic origin**; (5) **chlorotic anemia** with seizures of intense **thoracic angina**. Stanley Eiss (Amer. Pract., May, 1914).

In 5 persons in whom the action of amyl nitrite on the venous pressure was tested, it was lowered, although in 1 this was preceded by a transient increase.

A similar result followed the giving of nitroglycerin in 7 subjects, with preceding increased pressure in 3. Payan and Giraud (C. r. Soc. de biol., July 10, 1925).

In **localized spasms of the vessels**, such as are present in **Raynaud's disease** and **erythromelalgia**, the nitrites sometimes prove of service, given in gradually increasing doses.

Attention called to the value of nitroglycerin in surgical cases, administered in doses of $\frac{1}{100}$ grain (0.00065 Gm.). He advises its use in incipient **senile gangrene**, and in all cases of impaired circulation in which **contracted arterial walls** are present. Even when the arteries seemed to be normal the author has used the drug with benefit in **local congestion**. Elvy (Brit. Med. Jour., Jan. 7, 1905).

Rigors are accompanied by peripheral vasoconstriction and are frequently relieved by inhalations of

amyl nitrite. The relief of **syncope** is explained in the same way. F. Hare (Clinical Journal, August 29, 1906).

In the **syncope** and **cardiac depression of chloroform anesthesia**, reports of a successful use of amyl nitrite have been made. The action of the drug in these cases apparently consists in a relaxation of the vessels, whereby the work of the greatly depressed heart is facilitated and the organ permitted gradually to resume its functions as the chloroform is destroyed or excreted. Bastedo was able with amyl nitrite to restore mice apparently nearly dead from chloroform. In the first and second stages of general anesthesia, either with chloroform or ether, amyl nitrite, according to Mühlberg and Kramer, will prevent the cessation of heart action sometimes resulting from the action of these two drugs alone.

Among the respiratory conditions in which the nitrites are used is **bronchial asthma**. Here the burning of potassium nitrate, generally in combination with belladonna or one of its congeners, tends to dilate the constricted bronchi through its conversion from a nitrate to nitrous acid or a nitrite during combustion, whence a bronchodilatation is produced through the direct action of the drug on the muscle-tissue of the arterioles. Early in the attack, inhalation of a few minims of amyl nitrite will be found useful. Its evanescent effect can be prolonged by the administration of sodium nitrite, nitroglycerin, etc.

In **hemoptysis**, occasional good results have been reported by various observers, from the administration of the nitrites of amyl and sodium. Placek, while recognizing the fact

that they seem contraindicated in cases with erosion of a large vessel or where a small aneurism has ruptured, does not hesitate to recommend the remedy in other instances, adding, moreover, that determination of the blood-pressure is important as an aid both in the prevention and the treatment of hemoptysis.

Amyl nitrite used fifteen times in 7 cases of **hemorrhage from tuberculous lungs**. Each time the drug exerted a prompt action. The hemorrhage was arrested and blood ceased to accumulate in the bronchial passages. Five or 6 drops of amyl nitrite were inhaled on a wad of cotton. The hemorrhage did not recur in the majority of cases. The inhalations were repeated several times afterward during the day. The nitrite was supplemented by the slower action of an enema of gelatin to which calcium chloride had been added, together with fluid extract of hydrastis internally. A. Braga (*Gazzetta degli Ospedali*, Dec. 22, 1907).

In **hemoptysis** amyl nitrite acts instantly, producing a fall in blood-pressure and giving time for clotting to take place. It does not interfere with coughing, and so permits the patient to get rid of the effused blood. Capsules can be easily carried by the patient, who can then inhale the contents of one as soon as hemoptysis begins, thus treating the condition at once and often preventing a worse attack. G. A. Grace-Calvert (*Brit. Jour. of Tuberculosis*, July, 1908).

In certain nervous disorders, more especially those characterized by **muscular spasm**, the nitrites are sometimes useful. Thus, in **epilepsy**, inhalation of amyl nitrite during the aura will tend to ward off the imminent paroxysm, and in **hystero-epilepsy** and **hysterical seizures** in general the attacks may be cut short by repeated inhalations of the same

remedy. In **tetanus**, during the severe paroxysm of muscular spasm often present while the patient is being fed, inhalation of a few drops of amyl nitrite may avert death by relaxing the tonic spasm of the respiratory muscles. In obstinate **hiccough** amyl nitrite may also prove of service.

Migraine attended by angiospasm, **headache** and other symptoms due to **cerebral anemia**, are not infrequently relieved by amyl nitrite inhalation. According to Loomis, the **vertigo of seasickness** may be similarly relieved upon the first appearance of the nausea. Osler is credited with the statement that in **tabes dorsalis** the continued use of nitroglycerin will relieve the neuralgic pains and lessen the frequency of the painful crises. According to H. E. Lewis, in **sciatica**, 2 minims (0.13 c.c.) of spirit of glyceryl trinitrate combined with morphine will frequently give relief where the morphine used alone is unsuccessful. In cases of **cyanosis** with venous congestion, a small, high-tension pulse and cephalic symptoms due to intracranial vascular disturbance such as dizziness, periods of unconsciousness, aphasia, and perhaps a paretic condition of one or more extremities, Gordon has pointed out the value of $\frac{1}{100}$ grain (0.0006 Gm.) of nitroglycerin, given two or three times a day.

The nitrites reduce vascular tension especially in the **incipient** or presclerotic stage of **arteriosclerosis**. In cases of presclerosis (early arteriosclerosis), nitroglycerin may be given for ten days, and followed by theobromine for ten days. Some success has been recorded from its use in **anemic vertigo**, or **Ménière's disease**. *Erythrol tetranitrate* is less effective

than nitroglycerin, but its action is more lasting. It is especially indicated in subjects of angina pectoris who are awakened in the night by the pains. *Sodium nitrite* yields less satisfactory results than the two latter-named. Huchard and Fiessinger (Jour. des praticiens, Dec. 11, 1909).

In **cholera infantum** with pronounced nervous symptoms, or when the skin becomes cold and clammy, Lewis deems nitroglycerin a life-saver when given in doses of $\frac{1}{250}$ grain (0.00026 Gm.) frequently repeated.

The **reflex vasomotor disturbances of the menopause and of the menstrual periods**, manifested by such symptoms as mental depression, cold hands and feet, unaccountable flushings, hysterical phenomena, and at times pain, can be relieved, at least temporarily, by nitroglycerin, employed internally in small doses. The **neuralgia accompanying dysmenorrhea** can be promptly relieved by the inhalation of a few drops of amyl nitrite.

Case of a multipara, aged 56, suffering from an excessive **menorrhagia**, which kept her chronically anemic, in which inhalation of amyl nitrite was followed by complete arrest of hemorrhage, and with stoppage of the menstruation in twelve hours. On several later occasions excessive flow was stayed by inhalations of this drug. Colman (Scottish Med. and Surg. Jour., May, 1905).

Given in doses of $\frac{1}{200}$ grain (0.0003 Gm.), hypodermically, with **morphine**, nitroglycerin prevents the **nausea** usually produced by the latter agent (Eiss).

In poisoning by certain drugs, amyl nitrite may be used with some expectation of useful effects. Rüdsky reported a case of **acute cocaine poison-**

ing in which the cyanosis and pallor of the face almost instantly disappeared, the respiration became freer, and the pulse fuller and slower, after amyl nitrite had been inhaled. Wood showed that the same drug has some power to allay the exaggerated spinal reflex action in **strychnine poisoning**. In **opium habit** the placing of a few drops of spirit of glyceryl trinitrate upon the tongue is asserted to have proven efficient in temporarily removing the craving for the narcotic drug.

In the mild **febrile affections of children**, spirit of nitrous ether in doses of 10 or 20 minims (0.6 or 1.25 c.c.) is of recognized utility in overcoming **oliguria** due to fever or acute congestion of the kidneys. A diaphoretic effect may be procured in place of the diuresis if warm coverings be placed around the patient. The same preparation may be used in adults where a mild but fairly continuous vasodilator action is desired. For diaphoretic purposes in adults it may be given in hot water in 20- or 30- minim (1.25 or 2 c.c.) doses every half-hour. It may also be used as a carminative in **flatulence**.

Favorable effects of amyl nitrite in skin affections described. **Eczema** often seems to subside promptly under the inhalation of amyl nitrite, the exudation both at the surface and in the deeper skin layers subsiding. The effect is ascribed to arterial hyperemia. The hyperemia following local application is useful in **frost-bite**, **urticaria** and **senile pruritus**. In **Raynaud's disease** the local asphyxia and acrocyanosis are improved by amyl nitrite. The hyperemia of a skin area treated locally with the drug persists for 10 minutes and only gradually disappears. Amyl nitrite acts through the intact skin on both the vasoconstrictor and vasodilator

nerves of the skin vessels. Winkler (Derm. Woch., Feb. 21, 1925).

C. E. DE M. SAJOUS.

AND

L. T. DE M. SAJOUS,
Philadelphia.

NITROBENZENE.—Nitrobenzene (nitrobenzol, essence or oil of mirbane, artificial oil of bitter almonds) is an almost colorless, oily liquid, having a sweet taste and the odor of bitter almonds. It is used as a cheap substitute for the true essence of bitter almonds; it is never used medicinally and is of interest solely on account of its toxicity.

POISONING BY NITROBENZENE.

—The diagnostic features are the odor, cyanosis, and asphyxia. Methemoglobinemia is present, the blood becoming chocolate-colored, very thick, and viscid. The pupils are dilated; the respiration rapid, irregular, and shallow; the pulse accelerated, thready, and, later, imperceptible. The temperature becomes subnormal. The muscles relax; consciousness may be lost. Nine drops have caused death. Poisoning may occur by inhalation or by internal use.

Treatment of Poisoning.—In poisoning by *inhalation* use **cold applications to the head, warmth to the trunk and extremities (hot-water bags or bottles), stimulants (internal and external, including electricity), hypodermics of strychnine, massage, artificial respiration** (prolonged until normal respiration is established).

If the poison has been taken *internally*, in addition to the above, **emetics**, followed by **gastric lavage**, liberal doses of **hydrated oxide of iron, whisky, and diluted ammonia; oxygen inhalations** and the **free use of liquids** are indicated. A pint (500 c.c.) of blood withdrawn by **venesection** and replaced by normal **saline solution** will hasten recovery. W.

NITROUS OXIDE.—Nitrous oxide gas (nitrogen monoxide, "laughing gas") was discovered by Priestley, and its anesthetic properties recognized by Humphry Davy in the beginning of the nineteenth century.

Not until about forty years later, however, in 1844, was the compound employed for practical anesthetic purposes by Horace Wells, a dentist of Hartford, Conn.

Nitrous oxide, N_2O , is a colorless gas, heavier than air, of neutral reaction, and with a slightly sweetish taste and odor. It dissolves in an equal volume of water and can easily be liquefied by pressure. It is not itself inflammable, but liberates oxygen in the presence of burning substances, the combustion of which it thus supports. The combustion of carbon and phosphorus is fostered by it almost as well as by oxygen gas, but at the relatively low temperature of the human body it fails to give up its oxygen, thus being without efficiency as a supporter of oxidation in living tissues.

Nitrous oxide may be made by gradually heating ammonium nitrate. $[NH_4NO_3]$ —or preferably a well-dried mixture of ammonium sulphate and sodium nitrate—to $250^\circ C$. in a retort or flask; the nitrate is thus decomposed into nitrous oxide and water. The gas is then freed from any trace of chlorine and nitric oxide by passage through warm solutions of caustic alkali and of ferrous sulphate, and collected over hot water. Liquefied by pressure, the gas is supplied in cylinders, from which it issues again in the gaseous state as soon as pressure is released. Fifteen ounces of the liquid nitrous oxide yield 50 gallons of the gas.

PHYSIOLOGICAL ACTION.—

Locally, nitrous oxide is devoid of irritant power.

General Effects.—**NERVOUS SYSTEM.**

—Although many early observers held that nitrous oxide exerted its

anesthetic effect merely through exclusion of oxygen from the central nervous system, the nervous tissues being placed in a condition of partial asphyxia owing to the cessation of oxygen intake in respiration, it has since been proven in various ways that nitrous oxide *per se* exerts a distinct depressant action upon the brain centers.

Paul Bert has demonstrated very clearly the narcotic action of nitrous oxide in experiments both on animals and man. Observing that inhalation of a mixture of 80 per cent. of nitrous oxide with 20 per cent. of air caused only imperfect anesthesia, while pure nitrous oxide caused asphyxia, he contrived, by administering a mixture of 80 per cent. of nitrous oxide and 20 per cent. of oxygen at a pressure one-fourth higher than the ordinary atmospheric pressure to animals in a glass case, to make these animals absorb as much nitrous oxide as if they were breathing it pure at the ordinary pressure, and also as much oxygen as if they were breathing air. In spite of the complete absence of asphyxia afforded by this procedure, complete anesthesia was noted, which anesthesia could be kept up with impunity for three days. Goldstein found that frogs, which are capable of resisting asphyxia for one or more hours in non-sustaining gases such as hydrogen and nitrogen, become narcotized in a few minutes when placed in nitrous oxide. Clinically observed phenomena suggestive of the same fact, viz., that nitrous oxide anesthetizes through a special depressant action on the nerve cells and not through asphyxia, are enumerated by Parsons as follows: (1) the induction of analgesia before cyanosis ap-

pears when the gas is inhaled pure; (2) the fact that when nitrous oxide is combined with proper percentages of oxygen, with the patient showing even an overpink color, anesthesia is profound and satisfactory; (3) the fact that characteristic symptoms of anoxemia are not present during a correct gas-oxygen anesthesia. The customary asphyxial convulsions occurring at the end of about a minute in warm-blooded animals, with artificially occluded respiratory passages, fail to occur in well-marked form where pure nitrous oxide is instead administered—again demonstrating a narcotic effect of this gas on the nerve-centers.

It has been held, partly owing to the experiments of Wood and Cerna, who showed that even merely a 3 per cent. addition of oxygen to nitrous oxide delayed considerably the anesthesia, that asphyxia is a distinct contributing factor in the narcotic effect of nitrous oxide. That such asphyxia is not the chief factor is, however, now considered established.

Plethorics show more than average blueness under nitrous oxide; this is not alarming if their other symptoms are satisfactory. Persons of athletic type sometimes show a tendency to excitement during induction or while awakening, and it is well to carry them to a slightly deeper anesthesia than is ordinarily required. Alcoholics and drug addicts are by far the most difficult patients. A long induction is required, the anesthesia range is narrowed, and there are some such patients who cannot be anesthetized satisfactorily with nitrous oxide without premedication, as by morphine, $\frac{1}{6}$ to $\frac{1}{4}$ grain (0.01 to 0.015 Gm.), morphine and atropine, or chlorotone, 5 to 20 grains (0.3 to 1.3 Gm.), 1 hour beforehand. Heidbrink (Curr. Res. in Anesth., Aug., 1926).

CIRCULATION.—Nitrous oxide exerts little or no direct effect on the cardiovascular system. Indirectly, however, it tends to increase the blood-pressure and slow the pulse rate, through stimulation of the vasomotor and vagus centers in the medulla, respectively, when an asphyxial condition of the blood has been produced. The pulse is not so slow as in ordinary asphyxia, according to Cushny, because the vagus centers are rendered less active than usual by the nitrous oxide.

BLOOD.—Nitrous oxide dissolves in the blood, probably without combining with the hemoglobin. Accordingly it fails to impair the oxygen-carrying power of the blood as would be the case with carbon monoxide (coal gas), and is readily eliminated through the lungs as soon as inhalation of it is discontinued.

RESPIRATION.—The respiratory centers are slightly depressed by nitrous oxide itself, but become temporarily stimulated by carbon dioxide if an asphyxial condition of the blood is produced through the exclusion of oxygen.

METABOLISM.—Glycosuria has in occasional instances been noted after nitrous oxide inhalation. This is considered due to the accompanying asphyxia, not to the anesthetic gas itself.

NITROUS OXIDE AS AN ANESTHETIC.—Nitrous oxide is one of the safest of all anesthetics, only a few deaths having been recorded in millions of anesthetics in which it has been employed. Other pronounced advantages are the prompt anesthesia produced and the rapidity of recovery; the absence of vomiting and of respiratory and renal irrita-

tion; the lack of deleterious influence on phagocytosis, and the fact that the danger of untoward results is not increased by frequently repeated administrations.

The chief disadvantage attending the use of the pure gas, nitrous oxide, *viz.*, the briefness of anesthesia, is removed by combination of a suitable proportion of oxygen with the nitrous oxide, as described in a special section at the close of this article.

In addition to its extensive use by dentists for the painless extraction of teeth, pure nitrous oxide is also employed for surgical operations of short duration, as in opening abscesses, boils, or felons, closing sinuses, simple dilatation and curetment, breaking up joint adhesions, and reducing fractures and dislocations. In the weak, aged, anemic and very young it is best administered with oxygen. In brief operations it is usually the anesthetic of choice. It is valuable for inducing anesthesia prior to the administration of ether or chloroform, thus reducing the time of induction and diminishing the amount of the more dangerous liquid anesthetic required for the operation.

Nitrous oxide recommended as obstetric analgesic for use in the home, after experience in 77 cases.

The administration of the gas is begun when there is 2 or 3 fingers' dilatation, generally preceded by morphine, especially in primiparæ. Usually no oxygen is given. The N_2O bag is filled about $\frac{2}{3}$, and at the start of the pain, or a few seconds before, the patient exhales and takes 3 or 4 normal inhalations of gas, holding the last breath for a few moments. J. L. Day (Curr. Res. in Anesth. and Analg., Aug., 1926).

CONTRAINDICATIONS.—Circulatory abnormalities constitute the

most frequent contraindication to nitrous oxide, which is to be avoided both in well-marked atheroma, especially if high blood-pressure coexists, and in cardiac dilatation, with or without a valvular lesion. Mitral stenosis, aortic regurgitation, and the "beer heart" are generally held to contraindicate nitrous oxide, as does also the combination of high blood-pressure with a weak cardiac first sound. Buxton regards the anemic individual, the "overgrown" boy; the nervous, sensitive child subject to fainting; the child with congenital cyanosis, and the person with an hypertrophied heart as among the most dangerous types of individuals for nitrous oxide, syncope and asphyxia easily occurring in these cases. With care to obviate struggling and undue exclusion of air or oxygen, however, no absolute contraindication to gas anesthesia is presented even in these cases.

Marked respiratory embarrassment, especially if due to a swelling which will be made worse through venous congestion, contraindicates nitrous oxide anesthesia, but if the dyspnea be of minor extent, as is frequently the case in patients with tonsillar swelling, Ludwig's angina, glandular or other enlargements exerting pressure on the respiratory channels, enlarged thymus, large adenoid growths, intra-abdominal effusions or growths pressing on the diaphragm and heart, obesity, pleural adhesions, and general affections causing dyspnea, nitrous oxide may be used provided great care be taken to avoid all asphyxia during the anesthesia.

In the aged, intolerance of asphyxia and circulatory stress is likewise a feature to be remembered, especially

if chronic bronchitis is present; nitrous oxide anesthesia is not, however, contraindicated by old age *per se*. In pregnant women it should be borne in mind that excessive exclusion of air may injure the fetus or bring on labor, while in children marked jactitation results from similar carelessness in the use of the anesthetic.

Nitrous oxide cannot be relied upon to bring about general muscular relaxation, unless administered in combination with oxygen by an experienced anesthetist.

CHARACTERISTIC PHENOMENA OF NITROUS OXIDE NARCOSIS.—Inhalation of a mixture of nitrous oxide and air produces a condition of hilarity, motor disturbance, and partial insensibility which led to the popular application of the term "laughing gas" to nitrous oxide. If the mixture inhaled be one of 4 parts of nitrous oxide with 1 part of oxygen, a similar state is occasioned, in which the subject experiences a drumming sensation in the ears, indistinctness of vision, and a general feeling of warmth. Motor inco-ordination, laughter, hypesthesia, and at times drowsiness appear, but complete unconsciousness and loss of peripheral sensibility never occur.

If inhaled pure, as is customary in clinical work, through a close-fitting mask, nitrous oxide produces, after a period of induction averaging about fifty-five seconds, complete anesthesia lasting forty to forty-five seconds in ordinary adults and about 30 seconds in anemic persons and children. During the period of induction the subject may experience some of the symptoms already mentioned. At times, however, a condition of hyper-

esthesia precedes the anesthesia, and during this brief period hallucinatory impressions may be received that will remain firmly fixed in the brain upon recovery from the narcosis. During the initial moments of impaired consciousness, painless extraction of a loose tooth may be effected, though the patient has a vague idea that something is being done. A few seconds later, complete unconsciousness is established. The face, at first flushed, then pale, in

fest rigidity appears. In children jactitation appears with special readiness and promptness. The superficial reflexes are lost under nitrous oxide, but the knee-jerk and occasionally the conjunctival reflex, persist. Wide dilatation of the pupils generally accompanies complete anesthesia, no indication of danger—as in the case of ether—being, however, thereby presented. When the inhalation is stopped, recovery quickly occurs, almost invariably without nausea or any other unpleasant after-effect.

METHOD OF ADMINISTRATION.—Preparation of the Patient.

—Although nitrous oxide is often employed with success where there has been no particular preparation of the subject, abstention from food for some hours before the anesthesia is desirable. Belts, corsets, and collars should be loosened, and—especially in children—the bladder emptied before induction is begun.

Posture.—The subject should be so placed that the muscles are relieved of all tension and the respiration and circulation free of all hindrance. This is best attained by having him seated in a chair with head-rest, with his legs hanging freely, the trunk somewhat extended on the pelvis, and the head in a line with the body.

Apparatus.—This commonly consists of a pair of cylinders containing liquefied nitrous oxide, connected by tubing with a rubber gas-bag capable of holding 2 or 2½ gallons of gas. To the upper end of the bag is directly attached by a T-shaped metallic mount, provided with inspiratory and expiratory valves, a conical or rounded face-piece, which should fit accurately round the subject's mouth and nose. The metallic mount re-

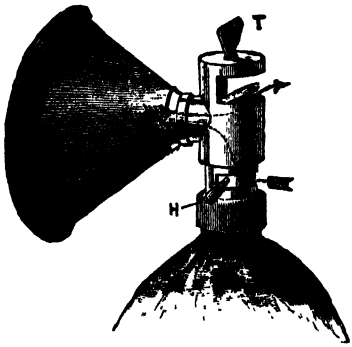


Fig. 1.—Face-piece, stopcock, and gas-bag for the administration of nitrous oxide gas only. (Sir F. Hewitt's apparatus.) The handle, *H*, opens or closes the air-way while it closes or opens the supply of gas from the bag. The tap marked *T*, when rotated, closes the expiratory valve and allows of rebreathing. The arrows indicate the course followed by air or gas.

about twenty seconds after the first inhalation, becomes slightly cyanotic (eyelids, cheeks, and ears), especially in florid persons. The heart action, at first fairly rapid, becomes slower—though still regular and full—as the narcosis deepens, while the respiration likewise slackens and, when anesthesia is complete, may be slightly stertorous. The muscles may partially relax, but in many instances jactitation of the extremities sets in, presumably owing to the deprivation of oxygen, and where asphyxia is permitted to attain a certain degree mani-

ferred to is available in several forms, among the best known being Hewitt's and the three-way stopcock form (see Figs. 1 and 2). In each the object of the device is to provide for three possibilities, according to the condition of the slots in the metallic mount, viz., the patient may be made either to inspire and expire air, to inspire gas and expire it into the atmosphere, or to inspire gas and ex-

pire nitrous oxide. Only one cylinder is drawn upon at a time, the second being reserved for when the first has been emptied; the first should then be at once replaced.

Administration.—The anesthetizer should begin by testing the apparatus to make certain that the valves are in good working order and that the gas passes into the bag freely. Upon application of the face-piece to the

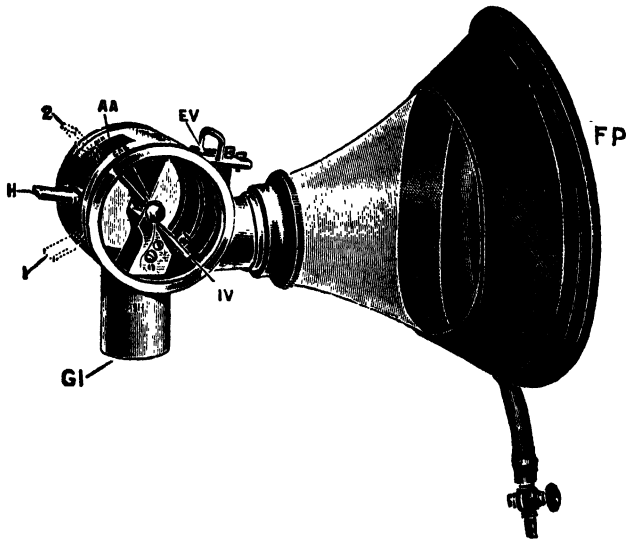


Fig. 2.—Three-way stopcock. (Mr. F. Coleman's principle.) *FP*, face-piece; *EV*, expiratory valve (rubber); *IV*, inspiratory valve (aluminium); *AA*, air aperture; *GI*, gas inlet tube to which Cattlin's bag is attached; *H*, handle set for nitrous oxide; 1, handle set for air; 2, handle set for rebreathing into bag.

pire it into the rubber gas-bag. Some face-pieces are made of transparent celluloid, thus allowing a view of the patient's mouth during the administration, and are provided with a hollow rubber rim which can be inflated to any desirable degree with air, close adaptation to the face being thereby facilitated. The valves admitting gas from the cylinders into the gas-bag are operated either with the foot or by hand. The cylinders are made in three standard sizes, yielding respectively, 100, 250, and 450 gallons of

patient, no especial directions about his breathing need be given unless the respiration be hurried and nervous at the time, when he should be instructed to breathe steadily in and out, slowly and without straining. Excessively deep breathing is apt to result in a too rapid anesthesia and a correspondingly quick recovery from the gas. The face-piece should be held against the face with the thumb and forefinger just tightly enough to prevent leakage of air under the cushion; the remaining fingers may

be advantageously used in supporting the patient's jaw, which tends to drop as anesthesia supervenes. When the valves are seen to be working properly and the patient has become accustomed to the face-piece, nitrous oxide should be admitted, rapidly enough to keep the gas-bag two-thirds full, but with avoidance of sudden gushes of gas from the cylinder, lest freezing of it and occlusion of the exit take place. The gas should preferably be admitted into the face-piece at the beginning of an inspiratory movement. Where, after a period, duskiness is noted, twitching about the eyes is seen, or jactitation of the extremities takes place, the gas should be turned off and air allowed to enter for one complete inspiration.

Among the best indications that unconsciousness has been produced are, an automatic type of breathing similar to that during sleep, though more frequent; a dusky, livid color of the face, and a distant, expressionless look in the eyes. There may be oscillation or fixation of the eyeballs, quivering of the eyelids, dilatation of the pupils, slight stertor of breathing, and jerky movements of the limbs. Flaccidity of the arms, with descent of an arm previously held up voluntarily by the patient, may also serve as a sign of anesthesia (unless interfered with by anoxemic rigidity). The face-piece should then be removed and the operation proceeded with.

Primary saturation of the patient with nitrous oxide sometimes fails to produce sufficient relaxation for certain operations. Such relaxation occurs only when the gas is sufficiently concentrated in the tissues and is associated with enough oxygen to prevent anoxemic rigidity. *Secondary saturation* with nitrous oxide, follow-

ing momentary reoxygenation, intensifies the anesthesia and produces sufficient relaxation for any operation. Successful and safe employment of this procedure depends on an apparatus capable of inflating the lungs with oxygen should the patient be crowded, intentionally or accidentally, into spastic apnea. It depends also on an accurate interpretation of the signs of anesthesia, but disregarding the presence or absence of cyanosis as an anesthetic sign. The procedure does not lead to postanesthetic sequels. It is held by the writer to be safer than an ether sequence or combined gas-oxygen-ether, and convalescence is better when even a small amount of ether is avoided. McKesson (Jour. Amer. Med. Assoc., May 29, 1920).

Returning consciousness is indicated by a reappearance of the normal color of the face, loss of the livid hue of the lips, a return of expression to or normal movements of the eyes, movements of the body or a limb, crying out (though the patient be still actually unconscious), and perhaps a noticeable contraction of the pupils. Unless the face-piece is still in position, operative work should then be discontinued, otherwise nightmare sensations and severe struggling may ensue.

Deviations from the natural course of nitrous oxide anesthesia, sometimes requiring corresponding modifications in management, may be noted in various types of individuals. Thus, in strong, muscular persons and in alcoholics a tendency to struggling and fighting is not infrequently manifested. In these patients a **too free access of air during the beginning of the induction period**, and also a **too strict exclusion of air in the later portion of the period**, are to be avoided. Before marked lividity or

jactitation occurs, **air should be admitted** and the depth of inspiration be increased by **lifting the lower jaw upward and forward** (Buxton). Care should be taken that the **face-piece fits closely over the face** in these cases. In anemic, feeble, and neurasthenic patients, both rapid anesthetization and rapid return to consciousness or perception of pain are characteristic. Here undue air exclusion is prejudicial, **slow induction with free admission of air (or preferably oxygen)** being advisable; the gas should be **diluted more and more until just before the face-piece is taken off**, when a **final supply of pure gas** may with advantage be given. Where breathing is shallow in these cases, **pressure upon the jaw or thorax** may be advisable to excite deeper inspiration. In children jactitation soon occurs unless **air or oxygen** is admitted with the nitrous oxide. Contraction of the bladder and vomiting should be guarded against in them by **previous urination and abstention from food for three hours before the operation**.

Among the possible minor complications of nitrous oxide anesthesia are retching or vomiting, due to swallowing of blood and mucus, the fixing of the mouth open with a dental prop, or idiosyncrasy. In the latter case, the retching occurring early, resort to another anesthetic may be necessary. Nervous individuals at times hold the breath—a condition that may be overcome either with **reassuring words** or by **pushing the lower jaw forward rhythmically**. "Gagging," generally occurring in smokers with irritable pharyngeal walls, may be remedied by **pushing the nitrous oxide** or, if previously

known to be likely, prevented by **spraying of the throat with a 2 per cent. solution of cocaine**.

UNTOWARD EFFECTS.—A. During Anesthesia.—Cyanosis, usually encountered among heavy, plethoric persons, particularly if past middle age, is generally remedied by **admission of air or oxygen**; if not, the nitrous oxide anesthesia should be abandoned.

Pallor during induction may be the forerunner of syncope, and demands early treatment, *e.g.*, **lowering of the patient's head**. Syncope, a rare complication of nitrous oxide anesthesia, may occur either before anesthesia is complete or when the operation is begun, and takes place chiefly in the anemic, the feeble, and those in whom breathing is, for any reason, hindered. Fright and shock may be factors in its production. Tendency to faintness under nitrous oxide should be antagonized with such measures as the use of **smelling salts**, **rubbing the hands**, and **slapping the face and chest with towels moistened with cold water**. Buxton, in minor degrees of faintness, recommends **bending the patient's body down** so that his face is placed between his knees, as well as **oxygen inhalations**. In more pronounced cases he has found partial or total **inversion of the patient** very useful.

Cessation of breathing in profound nitrous oxide narcosis in young children may be remedied by **compression of the lower part of the chest between the hands**. The same procedure is employed by Buxton in adults where interruption of breathing lasts longer than five or six seconds.

In **asphyxia** due to foreign bodies such as vomitus or teeth, mechanical

removal of these bodies, with tracheotomy as a last resort in case the maneuvers fail, is indicated.

Laryngeal spasm, a rare complication, can usually be overcome by rhythmic traction upon the tongue (Buxton).

Epistaxis, hematemesis, and hemoptysis in phthisical cases, are other possible accompaniments of nitrous oxide anesthesia.

Death under nitrous oxide has been known to occur in occasional instances, though it is doubtful if the action of the gas *per se* was the cause of exitus in any of the cases reported. In a fatal case observed by Olow necropsy showed syphilitic changes in the aorta, secondary hypertrophy of the heart, coronary sclerosis, and degeneration of the heart muscle. He attributes the asphyxia to narrowing of the oropharyngeal aperture, giving rise to impeded respiration, especially through the mouth, which, as Thewky has pointed out, occurs mostly in cases with large and flabby tongues. In similar cases, prompt tracheotomy might save life.

Artificial respiration is to be borne in mind as the remedial procedure *par excellence* where a serious asphyxial state or respiratory depression develops in nitrous oxide narcosis.

B. After Anesthesia.—After-effects from nitrous oxide rarely occur. **Vomiting** after oral operations is generally not due to the anesthetic, but to swallowing of blood. In the early months of pregnancy, as well as in children, vomiting follows with somewhat unusual frequency.

A feeling of weakness or sleepiness complained of by the patient after the anesthesia can be overcome by deep

inspirations or lowering of the head. Persons who fail to recover strength and comfort promptly upon cessation of the anesthesia should be required to stay recumbent on a lounge for half an hour.

Severe headache, nausea, malaise, slight vertigo, transient insomnia, anosmia, and albuminuria are infrequent sequelæ.

Apoplexy and hemiplegia have been known to occur as a result of nitrous oxide anesthesia, presumably owing to the rise of pressure produced by an asphyxial state of the blood. The frequency of such cases has, however, been often exaggerated.

NITROUS OXIDE-OXYGEN ANESTHESIA.—Although the administration of nitrous oxide can be somewhat prolonged by allowing the patient occasionally to breathe air, prolonged anesthesia without cyanosis or jactitation cannot well be obtained without the use of oxygen. Originally presented by Paul Bert, this method was largely developed by Sir Frederic Hewitt, and more recently further perfected by Teter and adapted for major surgery. It has been claimed that it may be used in diabetes, regardless of the character or length of operation; that it is not irritating, thus preventing accumulation of mucus in the air passages, and not depressing on the pulse or respiration; also that it tends to prevent shock, and causes no fear and thus rarely provokes struggling or outcry. It is contraindicated in cardiovascular degeneration, defective lung ventilation, and old people showing degenerative processes.

According to Teter the ideal patients for this method are the very weak, the debilitated. It is not ideal for



Teter regulated pressure apparatus with vapor warmer and all attachments.

major surgery when a large amount of anesthetic is required. But even here it is useful as an adjunct to complete local anesthesia.

The forms of apparatus now in general use comprise a stand bearing one or more cylinders each of nitrous oxide and of oxygen gas-bags, a mixing chamber, a tube, and a face-

piece. Teter's apparatus also includes pressure regulators, a vapor warmer, and an ether attachment permitting of the addition of from 1 to 20 per cent. of ether vapor to the gas where there is persistent rigidity. About 100 gallons of nitrous oxide and 20 gallons of oxygen per hour are used with the Teter apparatus.

In some clinics an injection of atropine and morphine, with or without scopolamine, is given one hour and a half or more before the anesthesia. In beginning the induction no oxygen, or only 2 per cent., is mixed with the nitrous oxide. Later, a larger admixture, usually not exceeding 10 per cent., is made, the anesthetist striving, by constant regulation of the mixture, to steer between cyanosis, due to insufficiency of oxygen, and excitation, due to an excess of it. The induction period occupies $1\frac{1}{2}$ to 3 minutes' where oxygen is added from the start. The necessity for oxygen augments progressively with the duration of administration, but the absolute amount used varies considerably according to the age and condition of the patient.

Although Teter was able to tabulate 9882 administrations of nitrous oxide-oxygen for general and oral surgery with but one fatality, others have not had such favorable results. Gwathmey reported 3 fatal cases in 2500, and Titus recorded 26 fatalities. According to Welborn (Surg., Gyn. and Obst., July, 1923), there is a liability in the second stratum of the stage of anesthesia to the occurrence of a spasm of the muscles which, while actually calling for more oxygen, may be misconstrued by an inexperienced anesthetist as requiring more gas, with death as a result.

While nitrous oxide-oxygen cannot cause relaxation as profound as does ether, it is possible to relax satisfactorily the average patient. A hypodermic of morphine and atropine of proper dosage assists both relaxation and anesthesia. Laparotomies present the greatest difficulty; self-retaining retractors are advisable. Operating with the "feather touch" and

avoidance of sudden, jerky movements are very helpful. Blocking the abdominal nerves on one or both sides with 0.5 per cent. procaine and also infiltrating the peritoneum before it is opened definitely aid relaxation. Nitrous oxide-oxygen is pre-eminently the safe anesthetic in diseases of the kidneys, pancreas or lungs, and less urgently in nervous diseases and toxic cases. It can be given in any case provided enough oxygen is allowed to supply the needs. L. A. Rethwilm (Curr. Res. in Anesth. and Analg., Oct., 1926).

C. F. DE M. SAJOUS

AND

L. T. DE M. SAJOUS,
Philadelphia.

NOMA. See MOUTH, DISEASES OF.
NOSE AND NASOPHARYNX, DISEASES OF.—Three diseases—ACUTE RHINITIS, HYPERESTHETIC RHINITIS (HAY FEVER), and ADENOID VEGETATIONS—have been treated in separate articles, to which the reader is referred.

CROUPOUS RHINITIS.

This is an acute inflammation of the mucous membrane of the nose which occurs in both children and adults. It is characterized by the deposit of a fibrinous exudate upon the surface of the mucosa, which does not show any tendency to undergo organization. Aside from nasal diphtheria, which is considered under the general subject of diphtheria, we occasionally meet with cases of acute rhinitis accompanied by the formation of a false membrane. This, however, is a comparatively rare condition. It must always be differentiated from *nasal diphtheria* and the patient should be isolated until the diagnosis is positively established by bacteriological examination. In most instances the disease is of bacterial

origin, but is not due to any specific micro-organism, the various forms of staphylococci and the *Streptococcus pyogenes* being most commonly found. It is thought by some that the gouty and rheumatic diatheses are influential in its production. It sometimes follows the use of caustics and the galvanocautery in the nose. The course of the disease is short, usually lasting but a few days.

TREATMENT.—The local treatment consists in the **removal of the pseudomembrane** by the application of **hydrogen dioxide** on pledgets of cotton, or used as a spray or douche by diluting with 3 parts of warm water, to be followed by an **alkaline antiseptic solution**, after which the membrane is dried and a 20 per cent. solution of **argyrol** applied by means of a cotton carrier. A more powerful germicidal effect may be obtained by the application in the same manner of **Löffler's solution**, which has the following formula:—

R <i>Toluolis</i>	36 parts.
<i>Alcoholis absoluti</i>	60 parts.
<i>Liquoris ferri chloridi</i>	4 parts.

As this solution produces considerable pain, it should be preceded by a 2 per cent. solution of **cocaine**.

Internally, divided doses of **calomel** should be administered and followed by a **saline**. The **tincture of ferric chloride** in 10- to 20- drop doses is also indicated.

PURULENT RHINITIS.

This is an inflammation of the nasal mucous membrane in which the discharge is purulent from the beginning. It is exceedingly rare in adults, but occurs more frequently in young children. The predominating symptom is a profuse, thick, puru-

lent discharge. Nasal obstruction occurs from the accumulation of the discharge in the nasal cavities. Emaciation frequently results from the inability of the child to nurse properly.

Bosworth maintains that purulent rhinitis occurs as a primary disease in childhood and, when neglected, results in atrophic rhinitis in adult life. Some authorities claim that it never occurs as a primary disease, but is merely a symptom, usually of suppuration of the accessory sinuses. There is nothing to prevent the nasal mucosa, when infected, from becoming a pus-producing membrane, just as any other mucous membrane becomes under similar circumstances. It is probable that a large proportion of the cases occurring in young children are due to infection of the nose from the vaginal secretions of the mother during birth, although the condition is rarely seen in its incipency. When occurring in adults, it is believed by some to be due primarily to the acute exanthemata. D. Braden Kyle described 2 cases in which the infection was carried to the nose by the fingers of the patient; in 1 case from the urethra, in the other from the ear.

In order to exclude *foreign bodies, suppuration of the accessory cavities, and tuberculous or syphilitic disease* as a cause of the purulent discharge, a thorough examination of the anterior nasal cavities should be made.

TREATMENT.—The **nose** should be **kept** scrupulously **clean** by spraying or douching with **normal saline solution**, or a saturated solution of **boric acid**. In young children an ordinary medicine dropper or a soft-rubber syringe may be used. In

older patients, a solution of **bichloride of mercury** in the strength of 1:8000 may be employed. The solutions should always be used warm. The nasal cavities should be thoroughly cleansed once a day with **hydrogen dioxide** applied with a cotton-wrapped applicator, or as a spray diluted with 3 parts of water, after which the membrane is carefully dried and an astringent application, such as **nitrate of silver**, 30 grains to the ounce, or **argyrol**, 20 per cent., made over the entire membrane. The internal administration of the **syrup of the iodide of iron** and **codliver oil** are usually indicated.

SIMPLE CHRONIC RHINITIS.

—Simple chronic nasal catarrh; chronic coryza; chronic nasal catarrh; chronic rhinitis.

Simple chronic rhinitis is a chronic catarrhal inflammation of the nasal mucous membrane, resulting from prolonged irritation of the mucosa or recurring attacks of acute rhinitis. It is characterized by relaxation, swelling, and boggy condition of the membrane, with an alteration in both the character and amount of the secretion.

SYMPTOMS.—The principal symptoms of which the patient complains are nasal obstruction and an increase in the amount of secretion from the nose, and frequently the nasopharynx as well. In the early stages the discharge is profuse and watery in character, while later, as the condition progresses, it becomes less profuse, thick and tenacious in consistency, mucopurulent in character, with a tendency to the formation of crusts. The nasal obstruction is usually intermittent and may be partial or complete, frequently alternating between the two sides.

It is generally more marked at night and the effect of gravitation is shown by the obstruction of the more dependent side during sleep. As a result of the nasal obstruction there is alteration in the voice, due to the absence of normal nasal resonance. Distressing symptoms, such as frontal headache, pain over the bridge of the nose, eyes and cheeks, are not likely to be marked unless the accessory sinuses become involved, but we frequently hear patients complain of a feeling of dullness, dizziness, loss of memory, partial loss of the sense of smell, errors of vision, closure of the Eustachian tubes, impaired hearing, and, if nasal obstruction is not relieved, the symptoms of pharyngeal and laryngeal involvement appear.

The patient suffering from simple chronic rhinitis is predisposed to frequent attacks of the acute form. Sneezing is often complained of, especially during the acute exacerbations, and in many cases the alæ and tip of the nose are congested and may become quite red. A sensation of itching or tickling in the nose is frequently present, due to the dryness and accumulated secretion, which causes the patient to constantly pick the nose, resulting in abrasion and ulceration of the septal mucosa and, even, perforation. In some patients, especially those of advanced age, the only symptom present is a profuse watery discharge, which at times is so abundant as to produce a great deal of annoyance.

Inspection of the anterior and posterior nares will show a relaxed, swollen, and boggy condition of the mucous membrane, especially over the lower portion of the septum and the inferior and middle turbinates.

More or less discharge will be seen upon the surface of the membrane. The color of the mucosa varies according to the general condition of the patient. While the membrane is usually redder than normal, yet there are many cases in which there is no increase in color; especially is this true in children, in whom there is often a great amount of discharge. In anemic individuals, although boggy of the tissue is apparent, the color is not heightened above the normal, and very frequently it is quite pale. On the other hand, in plethoric patients, the membrane is very much redder than normal and may even be livid. In the debilitated and those of advanced age, the membrane is usually pale and sometimes blanched.

DIAGNOSIS.—No difficulty should be experienced in making a diagnosis of simple chronic rhinitis. It is based upon the clinical history, the nature of the discharge, and the character of the mucous membrane, as determined by inspection and palpation.

ETIOLOGY.—Simple chronic rhinitis results from a prolongation of an acute attack or from frequently repeated attacks of acute rhinitis. The predisposing and exciting causes are identical with those of acute rhinitis. Frequent exposure to cold and draughts, a changeable and humid atmosphere, insufficient food, improper clothing, faulty ventilation, deficiency of sunlight and fresh air, and other unhygienic conditions are among the important predisposing factors. Congenital asymmetry of the nasal cavities, spurs and deflections of the nasal septum, adenoid vegetations in the nasopharynx, traumatism, foreign bodies and nasal polypi are local causes of the dis-

ease. The various diatheses play an important part as etiological factors, gouty, rheumatic, diabetic and strumous individuals being peculiarly susceptible to simple chronic rhinitis. Gastrointestinal derangements, chronic renal, hepatic, or cardiac lesions, affecting the nasal mucosa by irritation and vascular changes, may be responsible for the disease. It is frequently a sequel to the acute rhinitis of the newborn, and is especially liable to follow the acute form occurring in the infectious diseases. Certain occupations favor its development by exposing the mucous membrane more or less constantly to the irritating effects of vapors, such as ammonia, chlorine, bromine, and iodine, or to an atmosphere containing fine particles of dust, as in the case of millers, weavers, metalworkers, coal-miners, wood-carvers, stone-cutters, etc. Such substances as arsenous acid, potassium dichromate, mercury, the fumes generated by muriatic acid on lead solder, and the emanations of caustic acids, when inhaled for a long period of time, produce simple chronic rhinitis.

PATHOLOGY.—As a result of the constant irritation of the mucous membrane or the prolongation or frequent repetition of an acute inflammation, the changes in the vascular mechanism which accompany the acute condition become more or less permanent. The repeated or constant distention to which the blood-vessels have been subjected results in a loss of their normal contractility and they remain distended. The vessel walls become softened and there is an increased permeability with a continual escape of the elements of the blood, more particularly the white

corpuscles, which penetrate the connective tissue, where they proliferate, and, together with the proliferation of the fixed connective-tissue cells, produce new inflammatory tissue, thus inducing thickening and induration of the membrane. To a certain extent the venous plexuses of the turbinates take part in the inflammatory process and become enlarged from overdistention.

PROGNOSIS.—If allowed to go untreated, simple chronic rhinitis may remain stationary, or result in hyperplastic or atrophic changes in the mucosa. It may give rise to the formation of polypi and is often the origin of a catarrhal inflammation of the Eustachian tubes. With the removal of the cause and the institution of proper remedial measures the prognosis is favorable. When the affection is due to repeated attacks of acute rhinitis, recurrences are frequent.

TREATMENT.—The treatment of simple chronic rhinitis is both constitutional and local, and consists in the discovery and **elimination of the underlying cause** and the institution of proper local measures for the **relief of the pathological alteration in the nasal mucous membrane.** Before resorting to local or operative measures, the general physical condition of the patient must be carefully investigated. The presence of gout, rheumatism, lithemia, diabetes, cardiac, renal or hepatic lesions, or syphilis, necessitates proper **internal, dietetic, and hygienic treatment.**

If the affection is due to some external irritant the patient must be removed from such exposure. **Spurs and deflections** of the nasal septum, which produce obstruction to respira-

tion and drainage, or exert pressure upon the turbinates, should be regarded as etiological factors and **corrected by suitable operative treatment.** Likewise, the presence of **enlarged, deformed or cystic turbinated bones may also require operative treatment.** Before removing any portion of the turbinate, however, a careful examination by inspection and probe palpation must be made to determine that the enlargement is actually in the bony structure and not in the mucous membrane covering it. In all surgery of the nasal cavities our first consideration should be the conservation of the mucous membrane and the sacrifice of the turbinates indiscriminately cannot be too strongly condemned. If the turbinate bone is so deformed or diseased as to justify removal, this should be done by first dissecting the mucous membrane free from the bone and then removing as much of the bone as may be necessary. In those cases in which the inferior turbinate projects horizontally across the nasal cavity, producing obstruction and pressure upon the septum, I have obtained very satisfactory results by making a straight saw cut beneath the turbinate bone at its base, then fracturing the bone and forcing it back toward the outer nasal wall.

The local treatment of simple chronic rhinitis consists of measures directed toward the removal of the discharge, the absorption of the inflammatory products and the restoration of vascular tone to the membrane. Proper **cleansing of the nasal cavities** is of the utmost importance and is best accomplished by the use of **normal salt solution**, made by dissolving a teaspoonful of common salt

in a pint (500 c.c.) of warm water; or, an alkaline, antiseptic wash, such as **Dobell's** or **Seiler's solution**, may be used. The cleansing solution should be used twice a day, by means of an atomizer or nasal douche, and the patient is to carry out this treatment at home. Following the cleansing he is instructed to instill a few drops of an oily solution, such as the following:—

℞ *Camphoræ*,
Mentholisāā gr. ij (0.13 Gm.).
Olei eucalypti,
Olei pini pumilionis āāgtt. ij (0.12 c.c.).
Olei cinnamomi gtt. iij (0.18 c.c.).
Petrolati liquidi f℥j (30 c.c.).

Misce.

This is slightly antiseptic, stimulating and protective to the mucous membrane.

There is a great tendency upon the part of patients suffering from nasal affections to use the atomizer or nasal douche to excess. Constant washing of the nasal cavities, especially with strong solutions, produces irritation which often keeps up the very condition it is desired to relieve. While it is of the greatest importance to keep the nasal passage free from discharge, yet in many cases of simple chronic rhinitis, particularly of the moist type, it is not only unnecessary, but often even harmful, to use the nasal douche continuously twice a day for an indefinite period.

For the purpose of promoting absorption of the inflammatory products and restoring vascular tone, there should be applied to the anterior and posterior nares, after carefully cleansing and drying the membrane, stimulating or astringent solutions, depending upon the requirements of the individual case. Of the various

medicinal agents recommended for this purpose, equal parts of **compound tincture of benzoin** and **boroglycerin glycerite**, or a 25 per cent. aqueous solution of **ichthyol**, applied by means of a cotton-wrapped applicator, give most excellent results in many cases.

The **phenolated iodotannin glycerite** is highly recommended by Sajous, and is prepared as follows:—

℞ *Iodi* ℥ss (2 Gm.).
Acidi tannici ℥ss (15 Gm.).
Aqua Oss (250 c.c.).
 Mix, filter and evaporate to ℥ij (62 c.c.),
 and add
Phenolis gr. ij (0.13 Gm.).
Glycerini f℥iv (125 c.c.).

This preparation forms a clear solution, and by virtue of its oily consistency remains in contact with the membrane for a considerable period of time. In order to obtain the best effects it should be applied several times daily, after thorough cleansing of the parts. This may be done by the patient, who should be taught to make the applications by means of a feather, which is dipped in the solution and introduced into the nasal cavity and so manipulated as to bathe the mucous membrane thoroughly. In most cases the end of the feather can be pushed back into the posterior nares so that they may participate in the treatment. The applications should be made upon rising, twice during the day, and again on retiring, thus maintaining that continuous action, an essential factor in the treatment.

In some cases it may be necessary to resort to more astringent applications, such as a solution of **silver nitrate**, 20 to 40 grains (1.3 to 2.6 Gm.) to the ounce (30 c.c.), **tannic acid glycerite**, **zinc sulphocarbolate**,

2 per cent., or **zinc chloride**, 2 per cent., all of which produce their therapeutic action by contracting the blood-vessels and promoting absorption of the inflammatory products. At first these applications should be made every other day, and less frequently later, as the condition improves. At times the beneficial effects seem to be enhanced by alternating the different remedies. As an adjunct, the internal administration of **strychnine sulphate**, in $\frac{1}{30}$ grain (0.002 Gm.) doses, three times a day, is a valuable remedy for toning up the vascular system of the nasal mucosa.

When the changes in the mucous membrane have become so permanent that it fails to respond to the above treatment, more energetic measures must be resorted to. The application of chemical **caustics** or **escharotics** to the surface of the mucosa is recommended by many for the purpose of reducing the turbinal tissue, and of these agents **chromic acid** is the most valuable. The mucosa is first anesthetized by the application of a 4 per cent. solution of **cocaine**, after which the **chromic acid**, fused upon the end of a probe, is drawn along the most prominent portion of the turbinate. This results in a linear eschar, which, upon healing, permanently binds down the redundant tissue. A method of employing escharotics which obviates the surface scar is **submucous cauterization**, introduced by Norval H. Pierce. The mucous membrane is punctured near the anterior free border of the turbinate and a channel made with a blunt probe beneath the membrane, into which a fused bead of chromic acid is introduced.

Goldstein has improved this method by devising an instrument which conceals the bead of chromic acid in a cannula during introduction, after which the bead of acid is thrust from the end of the cannula and the instrument withdrawn. Immediately following the application of the chromic acid, the nasal cavity should be sprayed with an alkaline solution to prevent its spreading.

The **galvanocautery** is of value in properly selected cases, but, while still recommended by many, is used much less frequently than formerly. The mucous membrane should first be cocainized, then the electrode is introduced into the nasal cavity and the current turned on until a bright cherry-red heat is obtained, when it is brought in contact with the tissue and drawn from behind forward so that a linear cauterization results. The entire turbinate should not be cauterized at one time, but in three or four sittings at intervals of one week, thus limiting the amount of inflammatory reaction. The galvanocautery may also be employed submucously without producing much destruction of the surface mucosa. For this purpose long, pointed platinum electrodes are employed, which are passed deeply into the tissue and the cauterization is thus chiefly limited to the submucosa. Following the use of the galvanocautery the nares should be kept clean by means of **normal salt solution** or one of the **alkaline antiseptic solutions** previously mentioned.

The disadvantages of the application of escharotics and the galvanocautery to the surface of the mucous membrane are that they produce considerable slough, which may come

away and cause severe hemorrhage; that there is more or less destruction of the mucous membrane with resulting scar-formation, and the danger of infection and the formation of adhesions between the turbinate and the septum.

The employment of **systematic pressure** by means of **hard-rubber or metallic tubes or splints** is very effective in some cases. The size of the splint is selected according to the individual case, although it is preferable to begin with the smallest caliber and gradually increase the size. At first they should be introduced twice daily and permitted to remain for the space of a few minutes only, but after the treatment has been followed sufficiently long this may be increased to a much greater period. As great discomfort is frequently produced by this method it is seldom employed.

Massage is highly recommended by some for the purpose of stimulating the mucous membrane.

Some authorities recommend making **deep incisions into the turbinal tissues in the long axis of the bone**, thereby producing great depletion and resulting in sufficient cicatricial tissue to permanently reduce the enlarged condition of the turbinate.

A method which I have found most satisfactory in these cases is **submucous scarification**. The mucous membrane is first anesthetized by the application of a 4 per cent. solution of **cocaine**, after which a small, sharp-pointed knife, similar to that employed for incising the tympanic membrane, is introduced at the anterior free border of the turbinate and carried back beneath the membrane as far as necessary. The

knife is then turned in all directions and the submucous tissue thoroughly scarified. The inflammatory reaction which is thus induced results in permanent contraction of the membrane and has the advantage of not producing any surface scar.

INTUMESCENT RHINITIS.

This is not a distinct disease entity, but simply a different stage of chronic rhinitis, in which there is great turgescence of the mucous membrane covering the turbinates, more especially the inferior, due to the distention of the blood-vessels and an outpouring of exudate into the tissues.

SYMPTOMS.—The characteristic symptom is the sudden and transient swelling of the turbinal tissue, which produces marked obstruction of nasal respiration. The swelling may involve one or both sides, or may alternate between the two sides. There is also considerable secretion, which is sometimes thin and watery, but more frequently thick, tenacious, and mucopurulent.

Anterior rhinoscopy shows great tumefaction of the erectile tissue over the inferior turbinate. The mucous membrane appears moist and the color varies according to the general condition of the patient, but is usually red, smooth, and boggy; in anemic patients, however, it may be decidedly pale. Probe palpation produces a marked indentation, which immediately disappears when the pressure is removed. The application of a solution of cocaine or adrenalin chloride causes great contraction of the membrane, whereas in hyperplastic rhinitis it has little or no effect. Posterior rhinoscopy or the nasopharyngoscope will reveal

ETIOLOGY.—Hyperplastic rhinitis always results from a pre-existing simple chronic or intumescent rhinitis and is due either to a prolongation or neglect of these conditions. The constant increase in the blood-supply to the erectile tissues of the turbinates which accompanies repeated attacks of acute rhinitis or prolonged simple chronic and intumescent rhinitis is certain to produce an increase in the connective-tissue elements of the submucosa and eventually result in hyperplasia of the mucous membrane. Deformities and enlargements of the turbinated bones and spurs and deflections of the septum, by interfering with nasal respiration and drainage, and by causing pressure upon the neighboring structures, are important etiological factors. The disease is especially liable to occur in individuals who suffer from gout, rheumatism, lithemia, diabetes, and anemia. Some who believe that hyperplastic rhinitis depends wholly upon intumescence, which occurs only in certain areas provided with erectile tissue, lay stress upon cardiac, pulmonary, hepatic, and renal affections, which disturb the peripheral circulation and so produce active or passive nasal congestion, as factors in causing this form of rhinitis.

PATHOLOGY.—In this form of rhinitis the principal structural alteration is a quite marked increase in the connective-tissue elements of the submucosa. This new-formed connective tissue is a true hyperplasia and does not undergo contraction. The blood-vessels also participate in the pathological alteration, their walls becoming thickened and infiltrated, and there is an increase in the number of capillaries, from which the

new-formed connective tissue derives its blood-supply.

PROGNOSIS.—Under proper local and surgical treatment the prognosis is favorable. As the hyperplastic changes are localized, with the removal of the excess of tissue and the restoration of free nasal breathing, the remaining portion of the nasal mucosa, which has not undergone permanent change, will usually be sufficient to perform the nasal functions.

TREATMENT.—While local and internal medication are of some benefit in this affection, they must be regarded as only palliative. If permanent relief is to be expected, some form of **surgical interference** must be resorted to, with the view of **removing the excess tissue and re-establishing free nasal respiration.**

Any **systemic condition** which may be present, such as gout, rheumatism, diabetes, etc., should receive proper medicinal, dietetic, and hygienic **treatment.** Locally, the employment of a **cleansing alkaline solution** for the purpose of keeping the nasal cavities free from discharge is indicated. If there is any **deformity of the septum**, such as spurs, crests, or deflections, these should be first **corrected** by suitable surgical measures before operating upon the turbinates.

When the hyperplastic tissue is not excessive, the use of **chromic acid**, fused on a probe, or the **galvano-cautery** will often give satisfactory results. In dealing with anterior or posterior enlargement of the turbinates the **cold-wire snare** is the ideal instrument for their removal. The best type of this instrument is either the Sajous or Jarvis. The nasal cavity is first cleansed and the membrane thoroughly anesthetized

by the application of a 4 per cent. solution of **cocaine**, applied on pledgets of cotton and allowed to remain for a few minutes, followed by the application of **adrenalin** solution in the same manner. Under good illumination the wire loop is introduced and passed over the growth and gradually tightened until it is removed. In the case of posterior hyperplasia the operation is facilitated by introducing the nasopharyngoscope through the opposite naris, so that the manipulations can be carried out under the eye of the operator. Bleeding is controlled by **adrenalin chloride** solution or **hydrogen dioxide** applied on pledgets of cotton. Occasionally it becomes necessary to pack the nasal cavity with gauze, but this should be avoided whenever possible. Following the operation the nose should be cleansed twice daily with **normal salt solution** or one of the **alkaline antiseptic solutions**.

In enlargement of the body of the turbinate, D. Braden Kyle recommended making a **V-shaped incision** through the most dependent portion of the turbinate **and removing the tissue** with scissors, after which the two margins unite, resulting in a linear scar. For the removal of hyperplasia of the inferior surface of the lower turbinate, the **serrated scissors** or the **Jackson turbinotome** is very satisfactory.

ATROPHIC RHINITIS.—Dry catarrh; fetid catarrh; ozena; atrophic catarrh; chronic atrophic rhinitis; chronic fetid rhinitis, atrophic nasal catarrh; dry nasal catarrh; fetid rhinitis; rhinitis sicca.

This is an atrophic condition of the nasal mucous membrane, and

often the underlying bony structure as well, accompanied by the formation of crusts and a very offensive odor.

SYMPTOMS.—The chief symptoms of atrophic rhinitis are alteration in the character of the nasal secretion, with the formation of crusts, and the fetid odor. The most characteristic symptom is this very disagreeable odor, which is indescribable, but once encountered is not likely to be forgotten. It is generally believed to be due to decomposition of the secretion by the action of saprophytic bacteria, but the actual cause is still undetermined. The patient may or may not be conscious of the odor, as the sense of smell is always impaired and may be completely destroyed. Inspection will reveal large, roomy nostrils, the pharyngeal wall often being visible through the anterior nares. The inferior turbinate is invariably small or may be entirely absent in well-advanced cases, while the anterior end of the middle turbinate may appear to be enlarged. The mucous membrane is thin, pale, and firmly attached to the underlying bone. On probe palpation, instead of the normal soft, cushion-like sensation, the probe encounters a hard, resistant surface, which does not indent. Ulceration of the mucosa may be present, especially on the anterior part of the cartilaginous septum, and is usually caused by constant picking of the nose; this occasionally results in perforation of the septum.

Unless recently cleansed, the mucosa will be seen covered with a thick, tenacious secretion, which is closely adherent to all the structures. The color of the secretion varies in different cases, according to the stage

and severity of the disease, the atmosphere breathed, and the bacteria present. The discharge is often so thick and extensive as completely to occlude the nostril, and I have frequently removed a complete cast of the nasal cavity. Under these conditions, notwithstanding that there is a wide-open nostril, the patient suffers from nasal obstruction, which, however, is relieved after the removal of the crusts. In the early stage little difficulty is usually experienced in expelling these crusts, but as the condition progresses they become more tenacious and adherent, greater effort being required for their removal. Epistaxis frequently occurs from the vigorous efforts to dislodge the crusts.

The nasopharynx is invariably involved and the crusts are most tenacious and the membrane extensively affected. Upon lifting up the soft palate the crusts may be readily seen. The pharynx also becomes affected in many cases, although the crusts do not, as a rule, adhere to the pharyngeal mucosa, but this appears dry and glazed. The dryness may extend to the larynx in well-advanced cases and produce hoarseness and a hacking cough.

Pain is usually absent, although the patient sometimes complains of a sensation of fullness over the bridge of the nose and dull headache. Mental hebetude and depression are sometimes present, and the patient may suffer from melancholia as a result of self-consciousness arising from the disgusting odor which makes him a social outcast.

DIAGNOSIS.—The diagnosis of atrophic rhinitis is usually not difficult; the characteristic odor, the tenacious secretion with the formation of

crusts, and the marked atrophy of the nasal mucous membrane and turbinate bones, reveal the nature of the disease. It must be differentiated from *syphilitic necrosis of the nose*, but in the latter disease the process is generally more localized and does not present the extensive atrophy of the nasal structures.

ETIOLOGY.—The cause of atrophic rhinitis is still a disputed question, and while many theories have been advanced none have been definitely proven. One of those most highly regarded is that the disease is the terminal stage of hyperplastic rhinitis, the atrophic process being brought about by the pressure produced by the new-formed connective tissue, which decreases the blood-supply and interferes with the function of the glandular structure and ultimately leads to atrophy. According to Phillips, however, it can easily be demonstrated that atrophy often occurs without a preceding hypertrophy.

Heredity is believed by many to be an important etiological factor, inasmuch as the disease develops at a very early age and may occur in several members of the same family and, even, extend through two or more generations. This supposed hereditary influence is probably an inherited malformation of the bony structures of the nose, which predisposes the patient to nasal inflammation. The disease is frequently seen in individuals who have certain abnormalities in the shape of the skull, as well as malformations in the superior maxillary, palate, and nasal bones, and in whom there is a broad, flat conformation of the face, with very large and roomy nasal cavities and small

turbinated bones; and, while some authorities regard these changes as part of the atrophic involution, others consider them as antedating the disease and contributing to its production. The fact that the nasal cavities in atrophic rhinitis are lined with squamous epithelium in place of the columnar ciliated variety is believed by some to influence the development of the disease. The investigations of Meissner appear to prove that the flat, depressed nose of atrophic rhinitis is a contributory cause of the disease, and that the epithelial metaplasia, by which pavement epithelium appears in place of the columnar variety, is a primary condition.

Bosworth has maintained that the disease is always secondary to a purulent rhinitis in childhood.

Gruenwald advanced the theory that diseases of the accessory sinuses are the primary cause. However, there occur many cases in which there is not the slightest suggestion of accessory sinus disease. On the other hand, cases of accessory sinus suppuration occur in which, notwithstanding the fact that the nasal mucous membrane has been bathed in pus for a long time, there is no evidence of atrophic rhinitis. When the two conditions coexist, the accessory sinus involvement may be either primary or secondary. Hays inclines to the belief that many cases are due to an incipient sinus disease in childhood.

Various microorganisms have been isolated from the secretion by different observers, and by them assumed to be the cause of the disease, yet the etiological importance of bacteria has not been generally accepted as preponderating in the causation of atrophic rhinitis.

The organism most widely discussed is the coccobacillus of Perez and Hofer, or *Bacillus fastidus*. There is a widespread impression that this bacillus constitutes merely a secondary infection. According to Blanc and Pangalos, who made numerous clinical bacteriologic examinations, this organism, together with another which they call *B. ozogencs*, is, however, responsible for the fetid odor attending the disease. Hays found numerous varieties of organisms, including the Friedländer bacillus and *B. proteus*.

Apparently no one etiological factor is uniformly responsible. Fleischmann describes the source of ozena as a deficient activity of certain glands in the nasal mucosa, either congenital or acquired as a result of undernutrition, exhausting infections, or persistent rhinitis and sinusitis.

PATHOLOGY.—The pathological alteration in the mucous membrane consists in a desquamation of the normal columnar ciliated epithelial cells, which are replaced by squamous epithelium. There is a marked decrease in the connective tissue of the submucosa, with obliteration of the blood-vessels, together with a diminution or complete destruction of the glandular elements. The venous sinuses are usually entirely obliterated. As the process progresses, the mucous membrane becomes more or less fibrous and the underlying bony structures, especially the inferior and middle turbinates, undergo atrophic or degenerative changes.

PROGNOSIS.—The prognosis as regards a complete cure is unfavorable, as it is obvious that where the mucous membrane has been destroyed it can never be restored. If the case

is seen early, before extensive pathological alterations have taken place, it would seem that almost complete recovery might be expected, but the majority of these patients do not apply for treatment until the condition is well advanced. As to the relief of the disagreeable symptoms, much can be done by careful and persistent treatment.

TREATMENT.—Careful attention should be directed to the general condition of the patient, especially with the object of **eliminating any hereditary influence or systemic condition** which may have an **etiological bearing on the disease**. Internally, the administration of **potassium iodide** is of great value, and the patient should receive such other **constitutional treatment** as may be indicated in the individual case. Special attention should be given to general **hygiene**. **Irregularities or obstruction of the nasal cavities should be corrected by proper surgical measures**. Should there be any disease of the accessory sinuses this should be treated according to the methods described under DISEASES OF THE ACCESSORY SINUSES.

The two principal indications to be met by local treatment are thorough **cleansing of the nasal cavities** and **stimulation of the mucous membrane**, for the purpose of restoring as far as possible the function of the tissues.

In order to keep the nostrils free from the accumulated discharge **thorough and persistent cleansing** is required. For this purpose **normal salt solution**, made by dissolving a teaspoonful of common salt in a pint (500 c.c.) of warm water, is quite efficient, or one of the **alkaline antiseptic solutions**, such as **Dobell's** or **Seiler's**, may be employed. When

the discharge is very offensive, a solution of **potassium permanganate**, 2 grains (0.13 Gm.) to the pint (500 c.c.) of warm water, is most beneficial. The cleansing should be carried out at home, by means of the nasal douche, which should be used two or three times a day. The patient should be instructed in the proper use of the nasal douche, so as to avoid the danger of infecting the middle ear.

At each office treatment, the **nose** should be carefully **cleansed** so that every vestige of **crust or secretion** is **removed**. If the crusts are very tenacious, their removal can be facilitated by applying **hydrogen dioxide** on a pledget of cotton and allowing it to remain in the nostril for a few minutes, after which the crusts can be readily washed out. After all the secretion has been removed, the membrane should be carefully dried and some **stimulating application** made. Of the many medicinal agents recommended for topical application, **ichthyol** is largely employed and gives most excellent results in many cases. The following formula is highly recommended:—

R *Ichthyolis* ʒij (8 Gm.).
Glycerini fʒij (8 c.c.).
Aquæ q. s. ad fʒj (30 c.c.).
 Misce.

This should be applied over the entire surface of the nasal cavity by means of a cotton-wrapped applicator. A 25 per cent. solution of **argyrol**, applied in the same manner, is now extensively used and gives very beneficial results.

The various preparations of **iodine** have for a long time held a prominent place in the treatment of atrophic rhinitis and I have obtained very

satisfactory results from the following formula:—

℞ *Iodi* gr. v (0.3 Gm.).
Creosoti ℥v (0.3 c.c.).
Potassii iodidi gr. xxx (2.0 Gm.).
Glycerini ...q.s. ad f℥j (30 c.c.).

Misce.

The 3 **Mandel solutions**, which are most generally recommended, are as follows:—

No. 1.

℞ *Iodi* ʒss (2 Gm.).
Potassii iodidi ʒij (8 Gm.).
Glycerini fʒv (20 c.c.).

No. 2.

℞ *Iodi* ʒj (4 Gm.).
Potassii iodidi ʒiv (16 Gm.).
Glycerini fʒv (20 c.c.).

No. 3.

℞ *Iodi* ʒiiss (6 Gm.).
Potassii iodidi ʒvj (24 Gm.).
Glycerini fʒv (20 c.c.).

In this method of treatment, the milder solution is first applied for a short time, and the strength gradually increased until the stronger ones are tolerated. Better results are usually obtained if the stimulating applications are varied from time to time. Following the application of any of these stimulating solutions, much comfort will result from **spraying the nasal cavity with some oily solution**, such as the one mentioned under **SIMPLE CHRONIC RHINITIS** or the following:—

℞ *Camphoræ*,
Mentholis āā gr. iv (0.26 Gm.).
Petrolati liquidi f℥j (30 c.c.).

Misce.

This treatment should be carried out at first every other day, and as the condition improves the interval between the visits may be lengthened.

If ulceration of the mucosa is present this should be touched with a

solution of **silver nitrate**, 60 grains (4 Gm.) to the ounce (30 c.c.).

The application of **scarlet red** has been highly recommended. It is used in a 5 per cent. ointment in petrolatum, every two or three days, after carefully cleansing the nasal cavity.

Inhalations of stimulating volatile substances obtained from the **essential oils, cubebs, tar, eucalyptus, thymol, menthol, and ammonium chloride** have been largely employed.

The insufflation of powders, especially **iodoform** and **aristol**, has been recommended by some authorities.

The local application of pure cultures of **lactic acid bacilli** has been asserted to be highly beneficial, liquefying the crusts and soon improving the appearance of the mucosa. The solution is employed as a spray or simply dropped into the nostril.

A spray of 2 per cent. **dichloramine-T** or 0.1 per cent. neutral **acri-flavine** solution is useful (Hays).

The **high-frequency current** has been advocated, and is applied locally with special applicators. The **galvanocautery** should never be used.

Vaccines have given good results in some instances. Stock vaccines of the supposed specific organisms are available, but autogenous vaccines made from cultures of the nasal discharge have seemed more effective.

Local vaccine treatment advocated, autogenous vaccines containing 2 or 4 billion killed bacteria per c.c. being used. The stronger vaccine is sprayed into the nose on alternate days, while the weaker is injected under the mucosa of the turbinates, after preliminary cleansing. Of 8 patients, 4 were cured and 3 considerably improved. Rebattu and Proby (Jour. de méd. de Lyon, Dec. 20, 1923).

Great discomfort is often experienced by these patients owing to the absence of resistance to the passage of the air through the nares. To obviate this, various observers have resorted to the injection of **paraffin** to build up the inferior turbinate and reduce the width of the nasal passage to its normal size. A needle 3 inches long attached to a special paraffin syringe is required. Sufficient paraffin to reconstruct the entire turbinate may be injected at one time, or a number of small injections may be made at weekly intervals. The mucous membrane is first **cocainized**, after which the needle is inserted and passed along beneath the mucosa and the desired amount of paraffin injected.

Operative **displacement of the septum** to reduce the size of the larger nasal cavity has been carried out by Gleason and others.

Among other procedures that have been reported serviceable are the **Halle-Lautenschläger operation**, which consists in mobilizing the lateral nasal wall, displacing it permanently inward toward the midline, and clearing the maxillary sinus of dead bone and other tissues; the **Wittmaack procedure** of implanting the duct of the parotid gland in the maxillary sinus in order to exert a continuous detergent effect on the latter; and **Hinsberg's lead-plate suture operation**, in which the lateral nasal walls are mobilized and then drawn together by means of magnesium plates and wire sutures, to be removed some weeks or months later.

LUPUS OF THE NOSE.

The tubercle bacillus is invariably to be found in lupus. In lupus of the

nasal mucosa, a tuberculous family history is often obtainable. The disease is characterized by the formation of nodules of varying size, which have a tendency to break down and ulcerate. One or both nasal cavities may be involved. The most prominent symptom is nasal obstruction, due to the nodular growth, the degree depending upon the extent of the surface involved. There is usually slight discharge, which may become fetid. Pain is not a prominent symptom of lupus of the nasal cavity, although in certain instances it may be quite pronounced.

The ulceration is serpiginous in character, healing in one direction while spreading in another. The ulcer is shallow, round or ovoid, with an elevated and indurated margin, and is usually covered with inspissated secretion in the form of brownish crusts or scales. While the affection may be primary in the nose, in the majority of cases the nasal lesion is secondary to a lesion of the skin, the involvement of the mucosa taking place by continuity. When primary, it usually begins in the mucous membrane covering the anterior part of the cartilaginous septum, from which point it may spread to the floor of the nose and the turbinates. Perforation of the cartilaginous septum usually occurs. The alar cartilages may be attacked and become more or less destroyed. Involvement of the bony structures is very rare.

In some instances, instead of going on to ulceration, the nodules become softened and undergo absorption, leaving a bluish-white cicatrix. The disease is chronic in type and runs a slow course.

TREATMENT.—This consists in **X-ray** or **Finsen ray treatment**, or, if these fail, thorough **destruction of the lesion either by caustics, electricity or the curette**. The **nasal cavities** should be **kept clean**.

TUBERCULOSIS OF THE NOSE.

Primary tuberculosis of the nose is exceedingly rare, the nasal lesion generally being secondary to tuberculosis in some other portion of the body, usually the lungs. It is due to infection of the nasal mucosa by the tubercle bacillus. The disease manifests itself most frequently in the form of ulceration, which does not differ from a tuberculous lesion elsewhere. The most common site of the ulcer is on the anterior part of the septum, probably from the fact that abrasion of the mucous membrane is so frequent in this location. It may also occur on the floor of the nose or the turbinates, and may even extend beyond the mucocutaneous junction and involve the upper lip. The ulcer is shallow, with irregular, slightly elevated edges, usually not surrounded by a zone of inflammation, and its floor is covered with a yellowish exudate, containing tubercle bacilli. Miliary tubercles may be seen upon the floor and edges of the ulcer. There is a thick, mucopurulent discharge from the nose, which may become fetid. There is little or no pain. Occasionally there is hemorrhage from the ulcerated area. The ulcers show but slight disposition to heal, and if this does take place there is a marked tendency to recurrence.

Instead of the characteristic tuberculous ulceration the disease may

present itself in the form of a neoplasm which is irregular in outline, of varying size, reddish in color, and bleeds readily. The tumor shows a strong tendency to break down and ulcerate. It consists of a round-cell infiltration, with the formation of giant cells and miliary tubercles. Small numbers of tubercle bacilli are present. As a rule the only symptoms present in this form of the disease are those due to nasal obstruction. The diagnosis is confirmed by finding the tubercle bacilli in the discharge from the nose or in the tissues.

TREATMENT.—The **nasal cavity** should be **cleansed** twice daily with an **alkaline antiseptic solution**. The **ulcer** is **anesthetized** by a 10 per cent. solution of **cocaine**, after which it is thoroughly **curetted** and the base **cauterized** with **chromic acid** or **lactic acid**. When the lesion takes the form of a **neoplasm**, this should be **removed** with the **cold-wire snare**, and its **base cauterized**. **Iodoform**, **iodol**, or **aristol** may be employed by **insufflation**. The internal administration of **tonics** is indicated, and if a pulmonary lesion exists appropriate treatment must be instituted.

SYPHILIS OF THE NOSE.

Nasal syphilis may be either hereditary or acquired. In the congenital form, the disease is observed at two distinct periods of the child's life. In the early form, which corresponds to the secondary stage of acquired syphilis, the symptoms usually appear from the second week to the third month, rarely later, and take the form of a severe coryza. The nasal mucosa is red and swollen, and there is a profuse discharge, at first thin and watery, which

later becomes mucopurulent. The irritating nature of the discharge is shown by the excoriation of the nasal orifices and the upper lip. In some instances the nasal secretion shows a tendency to dry and form crusts. There is marked nasal obstruction accompanied by noisy breathing, the so-called "snuffles." Mucous patches may be discovered in the nose, and occasionally the cartilages and bones become involved, with resulting deformity. When the cartilages and bones undergo necrosis, the discharge increases, becomes purulent and bloody, is very offensive, and may contain fragments of necrotic tissue and sequestra of bone. The constitutional symptoms are severe and the nutrition is further impaired by the inability of the child to nurse.

In the later form of hereditary nasal syphilis, which is analogous to the tertiary stage of acquired syphilis, the disease usually manifests itself between the third year and puberty, and is characterized by gummatous infiltration of the nasal mucous membrane, which undergoes ulceration and produces destruction of the cartilaginous and bony framework of the nose. Great deformity of the nose usually results and perforation of the hard palate may occur. The discharge is purulent, streaked with blood, and exceedingly offensive.

The nasal manifestations of acquired syphilis conform to the three stages seen elsewhere. Primary syphilis may occur in the nose, but is very rare. When a chancre appears in the nasal cavity it does not differ from the primary lesion in other locations.

The secondary stage of acquired syphilis often presents nasal symptoms, but as they are not particularly severe nor of a serious nature, they are very likely to be overlooked, the patient be-

lieving he is suffering from acute coryza. The nasal involvement develops usually within the first six months and is synchronous with the secondary lesions of the mouth, throat, and skin. The nasal mucous membrane is red, swollen, and often edematous, and there is abundant discharge, which is at first thin and watery, but later becomes thick, mucopurulent, and sometimes offensive. Mucous patches may appear on the nasal mucosa. The symptoms of coryza are persistent and do not respond to any treatment except that directed against the specific disease.

In the tertiary stage of acquired syphilis the nasal lesions are most serious and formidable, involving as they do the cartilaginous and bony framework of the nose, and possibly extending to the bones of the face and skull. As a rule, these symptoms develop after a period of from five to fifteen years. At first there is a gummatous infiltration of the mucous membrane, giving rise to local or diffuse swellings, which are red or purplish red in color, but later become pale. The symptoms of nasal obstruction are more or less marked, according to the size and location of the gummata. In the beginning these swellings are hard and do not pit on pressure with the probe, but as the disease progresses they become soft and finally ulceration occurs. The ulcer is deep, with ragged edges and surrounded by an inflammatory zone. The ulceration gradually spreads, and the surface becomes covered with a purulent and bloody secretion, which has a tendency to dry and form yellowish-green scabs. The nasal discharge is abundant, dark in color, and has a horribly offensive odor. If the probe is used the presence of necrotic cartilage or bone may be detected. The cartilaginous septum is

usually the first part to be destroyed and this results in depression of the tip of the nose. The vomer is next to be involved and the bridge of the nose becomes flattened. The turbinated bones also undergo necrosis and may disappear in part or wholly. Perforation of the hard palate frequently occurs, and occasionally perforation into the cranial cavity. The entire nose may be destroyed, leaving two gaping apertures.

The diagnosis of hereditary syphilis is usually not difficult. In the early form the symptoms are generally pathognomonic, the parental history, obstinate coryza with a purulent, irritating discharge, the general appearance of the child and the shape of the nose being the chief diagnostic features. In the later form, the marked destruction of the cartilaginous and bony structures, the characteristic offensive odor, and the history of the case should make the diagnosis clear. The disease may be mistaken for *lupus*, but it should be remembered that syphilis of the nose is rapid and very destructive, while *lupus* runs a very slow course and does not produce much deformity. Syphilis has a special predilection for the bones, whereas *lupus* attacks only the cartilages.

Owing to its rarity, the diagnosis of primary syphilis of the nose is often obscure. As a rule, a positive diagnosis is not made until the appearance of secondary symptoms. However, with our present-day methods, it is now possible to demonstrate the presence of *Spirochæta pallida* in the initial lesion.

The secondary symptoms in the nose are often so slight as to be overlooked. The diagnosis must depend upon the history, symptoms, and constitutional manifestations.

The diagnosis of tertiary syphilis of the nose is usually not difficult. The history of the case, the necrotic lesions, and the foul odor make the diagnosis clear. The Wassermann reaction is of considerable diagnostic value in all stages of nasal syphilis.

TREATMENT.—Of first importance is the administration of appropriate **constitutional treatment**, as described under the general subject of Syphilis. This should be instituted as early as possible, and the method employed will depend upon the requirements of the individual case.

The local treatment consists mainly in **thorough cleansing of the parts**. In the early stage of hereditary nasal syphilis the nose should be cleansed by means of **normal saline solution** or saturated **boric acid solution**, introduced with an ordinary medicine dropper or a small, soft-rubber syringe. In the later stage the indications for cleanliness and disinfection are even more urgent, in order to control the offensive odor and render the ulcerative process as aseptic as possible. For this purpose one of the **alkaline antiseptic solutions**, such as **Dobell's**, may be employed, or if the discharge is very offensive a solution of **potassium permanganate**, in the strength of 5 grains to the ounce of water, may be used. In primary nasal syphilis, in addition to keeping the nares clean, the chancre should be dusted with **iodoform** or **iodol**. If there is any doubt as to the diagnosis of the primary lesion, it is perhaps wise to wait until by the appearance of secondary symptoms this has been removed, when constitutional treatment should be instituted. In the secondary stage, mucous patches and ulcerations should be

cleansed with **hydrogen dioxide** and a 40 per cent. solution of **nitrate of silver** applied. The same treatment is to be applied to the ulcerative lesions in the tertiary stage. When the **cartilaginous and bony structures** are involved, they should be thoroughly **curetted** and **sequestra** of bone **removed**. If, as a result of destruction of the cartilaginous support, the tip of the nose is sunken, the **injection of paraffin** is often of great value. When the bony structures have been destroyed and the bridge of the nose flattened, an **artificial bridge** may be inserted.

RHINOSCLEROMA.

This extremely rare disease of the nose is largely confined to the inhabitants of Russia, Poland, Austria, and Southern Europe, but few cases having occurred in the United States, and these usually in foreign-born subjects. It is characterized by the formation of hard, nodular enlargement of the nasal mucous membrane and the cutaneous structures of the nose, and may extend to the pharynx, larynx and trachea.

Occlusion of the nasal cavities is often the first symptom of the disease, and on rhinoscopic examination this is found to be due to the hard, nodular swellings of the mucous membrane of both the septum and turbinates. As the condition progresses complete stenosis of the nose occurs. The disease is painless and not accompanied by nasal discharge, since the affected tissues show no tendency to ulceration or inflammatory reaction. Rhinoscleroma progresses very slowly, produces no constitutional symptoms and is not dangerous as regards life, unless the larynx or trachea becomes involved, when serious or even fatal dyspnea may

occur. Changes in the external nose occur in only a small percentage of cases.

In the light of recent investigations, rhinoscleroma is now believed to be an infectious disease, caused by the Frisch bacillus or bacillus of rhinoscleroma, which in all cases is found within the Mikulicz cells and in the surrounding tissues.

The diagnosis is not easily made, more especially in the early stages, and the clinical course must be taken into consideration, which, together with the bacteriological and histological examination, will greatly aid in arriving at a positive diagnosis.

TREATMENT.—The treatment is only palliative. Surgical interference produces no permanent results. **Mercury** and the **iodides** are recommended by some. **Vaccines** have been employed with apparent beneficial results in a few cases. At the present time the **X-ray** and **radium** seem to offer the best prospects for permanent relief.

TUMORS OF THE NASAL CAVITIES.

MUCOUS POLYPI.—While nasal polypi are usually classed under the head of Tumors, it is now quite generally believed that they are of inflammatory origin, and not true myxomatous tumors. They are generally multiple and often bilateral. In the majority of instances they originate from some portion of the mucous membrane covering the middle turbinated bone or the ethmoidal region of the nose, and occasionally from the accessory sinuses.

Symptoms.—The principal symptoms are those due to nasal obstruction and the mechanical pressure and irritation, which are brought about by the

presence of the tumors. These will vary according to the size, number and location of the growths. As nasal polypi are of slow growth and productive of no pain, there may be an entire absence of symptoms until they have attained large size. In the early stage the symptoms are usually those of simple chronic rhinitis, the patient being susceptible to frequent attacks of acute coryza. There may be occasional interference with nasal respiration, which the patient endeavors to relieve by constantly blowing the nose or trying to force air through the nose from behind. As the polypi increase in size and number, the nasal obstruction becomes more or less constant. This symptom is increased in damp weather. As a result of the nasal obstruction the patient becomes a mouth-breather, and usually complains of dryness of the mouth and more or less irritation of the pharynx and larynx. There is alteration in the character of the voice from the absence of normal nasal resonance. Impairment of the sense of smell is common. A number of reflex complications, such as cough, asthma, hay fever and neuralgia frequently occur. Nasal polypi may produce obstruction of the ostium maxillare, the nasal duct and the orifice of the Eustachian tube.

There is considerable discharge, which, though usually thin and watery, may become mucopurulent. It is rarely offensive unless there is some associated condition. In long-standing cases broadening of the nose and alteration in the facial expression may occur. In some cases cerebral symptoms are noted, such as vertigo, aprosexia, and even epileptiform attacks.

Diagnosis.—No difficulty should be experienced in making a correct diagnosis, as inspection of the nasal cavity

will reveal the characteristic appearance of the growth. They present a white or grayish, more or less transparent and glistening appearance. The masses are well defined, soft in consistency, and indent readily upon pressure with the probe. They are usually pedunculated and freely movable. The application of cocaine aids in the diagnosis by contracting the tissues and increasing the view. When the polypi take their origin from the posterior part of the nasal cavity they may not be seen by anterior rhinoscopy, even when the parts have been contracted by cocaine, but these will be discovered by examination of the posterior nares.

Etiology and Pathology.—Much diversity of opinion exists regarding the etiology of mucous polypi. Some thirty years ago Sir Morell Mackenzie made the statement that the actual pathogenesis of the disease was quite unknown, and this seems to be equally true at the present day, none of the various theories promulgated to account for their origin having been universally accepted. Most of the older observers believed that these polypi were true tumors, regarding them as myxomata or soft fibromata, and while this view is still held by a few, it has been largely abandoned. Some have considered that they were essentially granulations modified by the peculiar conditions under which they grew. Many believe that polypi are edematous hypertrophies of the nasal mucous membrane, resulting from repeated congestion in the presence of a chronic inflammation of the mucosa covering the middle turbinated bone. Yonge lays special stress upon the mechanical changes in the glands, and says they undergo cystic degeneration by obstruction of their ducts, thereby forming polypi. While the in-

flammatory origin is generally conceded, it is impossible to explain why nasal polypi do not occur in every case of chronic inflammation affecting the middle turbinate. Some authorities claim that the inflammatory condition of the mucous membrane is secondary, the polypi acting as foreign bodies.

The association of nasal polypi and suppuration of the accessory sinuses has been frequently noted, and it was formerly supposed that the polypi were primary and the sinus disease secondary, the presence of the polypi either producing an aggravated rhinitis or mechanically obstructing the openings of the sinuses, the obstruction resulting in suppurative inflammation. Now, however, many observers incline to the view that the mucous polypi are secondary to the sinus suppuration. Grünwald believes that the disease is almost invariably caused by suppuration in the nose, arising as a rule from disease of the accessory cavities. While in the cases in which accessory sinus suppuration is associated with nasal polypi there is often evidence of a causal relationship, the sinus being usually primarily affected, many cases are seen in which there is no sign of suppuration in these cavities. On the other hand, suppuration of the accessory sinuses may exist for a long period of time without the development of polypi. We also see cases of bilateral polypi with unilateral sinus suppuration.

The theory that mucous polypi are merely a symptom of disease of the ethmoid bone was first advanced by Woakes, who claimed that they resulted from a chronic inflammatory process of the mucoperiosteum of the middle turbinated bone, associated with a morbid condition of the osseous tissue, which he stated was a necrosis.

Lambert Lack has more recently revived this theory, claiming that the ordinary mucous polypus was a simple localized patch of edematous mucous membrane, which was the result of disease of the subjacent bone. To prove this Lack examined pieces of bone removed from 30 cases of nasal polypus, and in every instance he found a rarefying osteitis which began as a periostitis. The fact that nasal polypi often contain fragments of bone would seem to indicate that, at least in some instances, they originate from disease of the underlying osseous structure.

Age, race and climate seem to exercise little influence upon the development of nasal polypi. Heredity and constitutional conditions likewise seem to have no etiological bearing. Anatomical defects, such as deviation of the septum, spurs and crests, which produce obstruction of the nasal cavities, have been considered as necessary to the development of the disease. Traumatism and foreign bodies are believed to be of minor importance.

TREATMENT.—Thorough removal by surgical measures is the only method of treatment to be considered. This is best accomplished by means of the cold-wire snare, the Sajous instrument being the most satisfactory. The application of a 5 per cent. solution of cocaine will prevent pain and reduce the congestion and swelling of the tissues, so that the polypus may be easily seen. The wire loop of the snare is passed around the polypus and manipulated until it is as close to the attachment of the pedicle as possible and then gradually tightened until the growth is severed. As a rule, very little bleeding follows their removal, and this may be controlled by a tampon

of cotton saturated with **hydrogen dioxide**. The number of polypi which should be removed at one time depends entirely upon the endurance of the patient. I have frequently removed large numbers at one sitting without any marked discomfort to the patient. Three or four operations, however, are sometimes necessary to clear both nasal cavities. In removing these growths as little of the normal mucous membrane should be sacrificed as possible. After complete removal of the polypi, a careful investigation must be made to determine the presence of any underlying condition which may be responsible for the origin of the disease. It is obvious that if the polypi are caused by an inflammatory condition of the turbinated bone or disease of the ethmoid bone, simply removing the growths will not be sufficient to cure the disease and recurrence will take place. Necrosis of the **ethmoid bone** may be detected by means of the probe, and if present this should be **removed** with curettes or bone-forceps. Suppuration in the accessory sinuses or extensive necrosis in the ethmoid region may require a **radical operation**. If the middle turbinated bone is enlarged to such an extent that it produces obstruction, the mucous membrane should be dissected free from the bone and sufficient of the bony structure removed to relieve the stenosis. There is often extensive thickening of the mucous membrane covering the middle turbinated bone, and this should be treated as described under **HYPERPLASTIC RHINITIS**.

MISCELLANEOUS TUMORS.—

Fibromata of the anterior nasal cavities are exceedingly rare. They usu-

ally spring from the lower margin of the middle turbinate, the septum or the floor of the nose. The tumor is of slow growth and the symptoms presented are those of nasal obstruction and pressure upon the surrounding structures. If the growth becomes very large, there may be marked external nasal deformity. **Removal** with the cold-wire snare is the only treatment indicated. As a result of degeneration or irritation these tumors may undergo malignant change.

Papillomata.—These wart-like growths are occasionally seen in the anterior part of the nasal cavity, at the junction of the skin and mucous membrane. They rarely attain sufficient size to produce obstruction, but from their location they are subjected to constant irritation and may undergo malignant change. They should be **removed** by means of a sharp knife. The application of caustics or any form of irritant to these growths is absolutely contraindicated.

Sarcoma of the nasal cavities can no longer be considered rare, judging from the number of cases reported. The most prominent symptoms are nasal obstruction and repeated epistaxis. There is usually considerable mucopurulent discharge and there may be more or less pain, depending upon the location of the tumor. As the growth increases in size, exophthalmos, widening of the bridge of the nose and marked facial deformity may occur. The diagnosis is based upon the history and anterior rhinoscopy. The tumor is soft, bleeds readily upon being touched with the probe, and presents an appearance which does not resemble

any of the ordinary nasal tumors. The positive diagnosis must be made by the removal of a portion of the growth for microscopic examination. The prognosis is always grave. The only treatment is early and thorough **extirpation of the neoplasm**. When the growth can be reached, removal with the **snare** and subsequent **curetting** may be possible. In suitable cases it may be dissected out with the **galvanocautery knife**. As the tumor is very vascular excessive hemorrhage may occur, and when it does should be controlled by packing the nasal cavity with gauze. As a rule, however, an **external operation** will be required to completely eradicate the tumor.

Carcinoma of the nasal cavities is of rare occurrence. It is less frequent than sarcoma and, as a rule, does not develop until after the fortieth year.

The progress of cancer in this location is slow, and the early symptoms are nasal obstruction, mucopurulent discharge, and severe pain. Ulceration occurs and the soft and bony structures break down and undergo necrosis. Hemorrhage usually occurs, but is less extensive than in sarcoma. The growth may extend into the sphenoid sinus, ethmoid cells and orbit, with resulting impairment of vision and possibly exophthalmos. As the disease progresses marked cachexia appears.

Radical operation is the usual treatment, but unless the nature of the tumor is recognized early, it is useless. In malignant tumors of the nasopharynx, New, of the Mayo Clinic, has reported good results from **radium**, many patients having continued well thereafter for 3 or 4 years.

SEPTUM, DISEASES OF THE. HEMATOMA.—

While septal hematoma is among the unusual occurrences, it can hardly be considered rare. The most frequent cause is trauma, in the form of a blow or fall on the nose. A blow on the front of the nose is more likely to produce hematoma than a side blow, for the reason that the former may cause a separation of the two plates of the septal cartilage, permitting an effusion of blood between them. The extravasation may also take place beneath the perichondrium. Hecht believes that hematoma without apparent cause is a characteristic feature of influenza, just as the hemorrhagic tendency of influenza is manifested in the brain, ears, accessory sinuses and on mucous surfaces in general. The hematoma may subside or become infected, forming a septal abscess. The treatment consists in the **application of cold over the nose** and **cleansing of the nasal cavities**. If the **swelling** does not subside, it should be **incised**, the **clot removed** and firm **bilateral pressure** applied by **tampons** or some form of **tubes**.

ABSCESS.—Abscess of the septum is by no means rare. The most common cause is trauma, which may consist either of injury to the septum or a blow on the external nose. The traumatic abscess is usually a suppurating hematoma, the formation of the pus having been antedated by the extravasation of blood from the effects of the blow. It is occasionally associated with erysipelas and may be a sequel to the infectious diseases, such as scarlet fever, measles, or typhoid fever.

In children it is more frequent during the first dentition, and especially

in those of scrofulous or rachitic diathesis, and may be associated with the purulent rhinitis of childhood. It may also be caused by diseases of the teeth. It may follow any severe inflammation of the nasal mucosa. It has been noted in children as result of foreign bodies.

Septal abscess occasionally follows the use of the galvanocautery on the nasal septum, but rarely the use of the saw or other cutting instruments.

In traumatic cases the abscess does not usually appear for some time after the injury, and there may or may not be evidence of trauma, in addition to the history. After the pus has formed there are marked redness, swelling, and edema of the mucous membrane of the septum, which obstruct the nostril on one or both sides, usually both, and can be retracted by pressure of the probe. The external nose is red, swollen and painful. Later distinct fluctuation may be detected by the probe and pointing may occur. There is probably some caries of the cartilage in most cases, but the mucoperichondrium is usually preserved intact so that regeneration takes place. Great sloughing or involvement of the bone septum is uncommon, and perforation rarely occurs.

Treatment.—The **abscess** should be freely **incised** at the most dependent portion, and the **cavity washed** out with **hydrogen dioxide**, followed by some **alkaline antiseptic solution**. The cavity should not be packed, but as there is a great tendency for the incision to close, a **strip of gauze** should be placed in the **opening**. The earlier the pus is evacuated, the less liability there is to destruction of the cartilage and deformity.

SPURS OF THE SEPTUM.—

These localized thickenings or projections upon the septum appear in the form of spines, crests, ridges, or rounded masses. They may be composed of cartilage or bone, or both; they occur with or without deviation of the septum. When the growth occurs upon the cartilaginous portion it is called an **ecchondrosis**, and when occurring upon the bony septum it is termed an **exostosis**. As a rule, they originate at the junction of the quadrilateral cartilage with the vomer and the spine of the superior maxilla, and also at the junction of the perpendicular plate of the ethmoid and the vomer. They most frequently extend from before backward, parallel to the floor of the nose, but may project at a right angle from the septum, and occasionally take a vertical direction. Septal spurs may be congenital, or result from malformation or traumatism. In many instances they are productive of no symptoms and do not require treatment. When they are of such size and location as to cause obstruction to nasal respiration and drainage, or, by pressure upon the adjacent turbinate, induce reflex irritation, their **removal** is indicated. In most cases this can be done under local anesthesia. The mucous membrane should first be dissected free from the underlying growth, before attempting its removal. This is not always an easy matter and is frequently unsuccessful, particularly when the spur is situated well back in the nasal cavity; but when it can be accomplished, healing takes place more rapidly, since the denuded area can be immediately covered with mucous membrane. After the flap of mucous

membrane has been raised, the projecting spur or ridge is removed, preferably by means of the nasal saw, although some operators prefer scissors, the biting forceps, spokeshave, or other cutting instruments. After the spur has been removed, the flap of mucous membrane is allowed to cover over the raw surface. Unless there is severe hemorrhage, the nasal cavity should not be packed.

DEVIATIONS OF THE SEPTUM.—A perfectly normal nasal septum is rarely seen, but unless the deviation is sufficiently marked to cause obstruction to nasal respiration and drainage, or to produce pressure upon the turbinates and consequent irritation, there may be no symptoms referable to the deformity. There is no doubt, however, that many of the catarrhal conditions of the nasal cavities are directly due to or perpetuated by irregularities of the nasal septum; therefore, the early recognition and correction of injurious deformities is of utmost importance. No satisfactory classification of deviations of the septum can be made. They may involve the cartilage alone, or the cartilage and bone, but are rarely limited to the bony septum. They may be horizontal, vertical, oblique, or sigmoid; they are often associated with spurs or crests, and they may or may not be accompanied by external deformity.

Symptoms.—Many of the minor degrees of deviation are quite free from active symptoms, and even in the more severe types the external deformity may be the only sign of the abnormality. When symptoms are present they are those of nasal obstruction with its effects upon both the adjacent structures and

distant organs. The symptoms of obstruction here do not differ from those due to nasal stenosis from other causes. Nearly always there is marked enlargement of the turbinal tissues on the concave side, which is of the nature of a compensatory hypertrophy, and patients, therefore, not infrequently complain more of obstruction on this side than upon the opposite, which is really more occluded. In cases in which the deviation is of the sigmoid type, both nostrils may be obstructed by the deformed septum. When the cartilaginous septum has been dislocated, the anterior margin of the cartilage projects prominently into the opposite nostril from the deflection, producing partial or complete occlusion of this side as well. External deformity of the nose is present in some cases, especially in those of traumatic origin. The contact between the deviated septum and the turbinates produces a chronic congestion probably quite as much from the irregular atmospheric pressure as from irritation, and this gives rise to repeated attacks of acute rhinitis. As a result of the chronic rhinitis, as well as from the mouth-breathing, the patient is subject to frequent attacks of pharyngeal and laryngeal inflammation, which eventually become chronic. The voice is altered from the lack of normal nasal resonance due to the nasal stenosis. The patient may also suffer from tinnitus aurium and impairment of hearing from interference with the proper ventilation of the Eustachian tubes. From reflex irritation there may be present such symptoms as cough, headache, hay fever, asthma, and neuralgic pains about the face.

The character of the deviation may be readily determined by anterior rhinoscopy; a convexity will be seen in one nostril, with a corresponding concavity in the other. There is usually considerable thickening at the point of greatest convexity. In the concave side prominent spurs or crests are frequently seen running horizontally along the sutural ridge, which unites the septum with the superior maxilla.

Etiology.—From the numerous theories which have been advanced as to the etiology of septal deformities, it would seem that the question has not been definitely settled and that no one etiological factor has been generally accepted. I believe that the condition may result from any one of a number of different causes, and that it is very difficult to determine the actual origin of any given case. Whether the deviation has been occasioned by congenital causes or faulty development in early life, or results from pressure from an enlarged turbinated bone, or whether it is brought about by one of a large variety of traumatic influences, is simply a matter of conjecture.

Some hold that heredity is the chief cause of septal deformities. Talbot believes that they are due to neuroses or stigmata of degeneracy, which cause either an arrest or an excessive development of the bones of the face, including the nose, one of the expressions of the neurosis being deformed septa. That a large proportion are due to congenital conditions or irregular development in very early life is probably true. Mosher claims that delayed eruption of the incisor teeth can displace the premaxillary wings and distort the

vomer groove, resulting in spurs and causing deviations anteriorly and posteriorly. Irregular development from different centers of growth would be sufficient to produce deviation of the septum from the median line.

The presence of adenoids in early childhood, with the associated mouth-breathing and the subsequent frequent attacks of acute catarrhal rhinitis, is undoubtedly a very potent factor in producing deviation of the septum. The high-arched, narrow palate which results raises the floor of the nose and thus diminishes the vertical diameter between the base of the skull and the nasal floor in which the septum must develop. This shortened diameter necessitates curvature of the nasal partition if it continues to develop.

Pressure from enlargement of the inferior or middle turbinated bones, as well as nasal tumors, polypi or foreign bodies, may be sufficient to push the septum out of alignment. Again, a single nasal passage may be occluded, which would tend to an overdevelopment of the free nostril with a resulting deviation of the septum toward the occluded side.

Many observers believe that traumatic causes are by far the most frequent. In a great many cases there is a history of trauma, but actual fracture or dislocation of the septum is not of common occurrence, and blows are rarely so severe at the time that they produce deformity. It is probable that in many instances the traumatism occurs in early childhood, while the bones are still soft, and since little attention is given to it at the time, the injury may be entirely forgotten when the nasal obstruction manifests itself. The fact

that men are much more commonly affected than women would tend to sustain the traumatic hypothesis. When the nasal septum is markedly deflected from the median line and there is no history or evidence of adenoids, and the palate is not high and arched, we may conclude that traumatism has probably been the cause of the condition.

Treatment.—Nothing short of **surgical treatment** is productive of good results when the septum has become deflected sufficiently to demand interference. A great many operations have been devised for this purpose, the deformities being so varied that no one method is applicable to every case. Many of them differ only in some slight modification of technique. It may be said, however, that all operations proposed for the relief of this condition have the same general principles, namely, that of removing the redundant tissues; breaking up the resiliency of the septum; conserving the mucous membrane, and restoring the septum, as nearly as possible, to a normal position. A few of the more important operations may be briefly described as follows:—

The Asch Operation.—Although enjoying less popularity now than it did in the early days of nasal surgery, the operation devised by Dr. Morris I. Asch, of New York, for the correction of septal deflections is still valuable in certain selected cases.

A special set of instruments is required for this operation and it is performed under general anesthesia. The blunt separator is introduced into the deviated side in order to break up any adhesions that may exist and also to ascertain the presence of any bony obstruction pos-

teriorly. Should such obstructions be found the sharp separator can be used for their removal, or it may be accomplished by an ordinary small bone chisel. The scissors is now introduced in a line parallel to the floor of the nose, the sharp blade being in the concavity and the blunt blade over the line of greatest convexity of the deviation; it is important that the blades should be at a right angle to the septum at the place of incision, as otherwise they may override and the scissors fail to cut through. The blades being firmly closed, the sharp one cuts through the cartilage into the opposite side with a distinct snap. The scissors is then opened and completely withdrawn. It is immediately reintroduced in the same manner as before, the blades this time pointing in a vertical direction, crossing the line of the first incision as near as possible at right angles and at its center; the scissors is now closed and the second incision made, after which the scissors is opened and withdrawn. We have thus four segments as the result of the crucial incision. The operator now introduces his finger into the stenosed nostril and forcibly pushes the segments into the concavity of the opposite side, effectually breaking them at their base. This part of the procedure must be done thoroughly and carefully, for on it depends the success of the operation. If the segments are thoroughly broken at their bases the resiliency of the cartilage is destroyed and the deviation cannot recur. The compressing forceps is now introduced, one blade in each nostril, and the septum compressed in order to straighten it still further

and force the broken segments so that they will more completely override each other. An iced antiseptic solution is now sprayed into the nostrils to check the bleeding, and the sterilized tubes are introduced, a snugly fitting tube into the side previously stenosed and a smaller one in the opposite. These serve to prevent hemorrhage and hold the septum in its new position. The patient is now placed in bed and iced compresses are applied externally. The patient should be kept in bed for two or three days, the cold compresses being applied externally during the first twenty-four hours. The nasal cavities should be sprayed through the tubes with an antiseptic solution. Twenty-four hours after operation the tube in the previously concave side is removed and not replaced. Twenty-four hours later the tube in the previously stenosed side is removed, the nostril cleansed, and the tube sterilized and replaced. This tube may be withdrawn daily for a week, and then on alternate days and gradually at lengthening intervals until healing is complete.

The Watson Operation.—A bevelled incision is made on the convex side of the septum, from behind forward and just beneath the angle of deflection, following the angle to its anterior extremity and then curving upward for a short distance. The incision is not carried through the mucous membrane of the opposite side. The upper part of the septum is then pushed over the lower portion into the opposite side, thus overlapping the lower portion. The same principle is applied when the angle is perpendicular, the incision then being made behind the angle from

above downward, the bevel at the base, forward from the first incision, forming a triangular flap. The posterior edge of the anterior portion is then pushed over the posterior portion. If both horizontal and perpendicular angles exist, both incisions are made, meeting at the base. The anterior fragment is first made to overlap the posterior, and then the upper portion, including the anterior segment, is made to overlap the basal portion. This forms a double locking and holds the anterior portion, which has no other support, firmly in a straight line. When the deflection extends into the bony septum, this is broken and replaced with forceps, there being no need for cutting or overlapping of the bony portion, as the fragments slide on each other and take up the redundancy, and, as the union is bony, there is no tendency of the deformity to return. The projecting base is removed after the parts have healed.

The Gleason Operation.—A thin saw is introduced along the floor of the nose beneath the deviation; the sawing is begun in a horizontal direction until the blade has penetrated somewhat deeply into the tissues, when the direction is rapidly changed from horizontal to nearly vertical. It is of the utmost importance that the saw should be held exactly parallel to the septum, in order that the cut shall be around and not through any part of the deviation. The length of the vertical crus is then quickly increased by means of a small bistoury curved on its flat, and the flap is thrust through the hole in the septum with the forefinger. While the finger is still in the nares it is carried up along the

anterior and posterior crura, in order to be certain that the edge of the flap has completely cleared them, and the neck of the flap is then sharply bent. It is not necessary to denude the edges that are in contact, as the pressure results in necrosis of the superficial epithelial layer of the mucosa, after which the parts unite.

The Kyle Operation.—This consists in making a horizontal V-shaped cut on the concave side of the septum by means of the triangular saw-file, which should not involve the mucous membrane of the opposite side. This V-shaped cut is made at the base of the septum on the concave side, while a straight saw-cut is made at the upper portion of septum on the convex side, for the purpose of breaking up the resiliency. The septum is then forced into the median line by the finger or forceps, after which it is supported by a metal splint in the previously occluded nostril.

The Roe Operation.—This is adapted to deviations of both the cartilaginous and the bony portions of the septum. A pair of fenestrated forceps are used, one blade of which is made in the form of an ovate ring, termed the ring or female blade, and the other is made in the form of a long, narrow, rounded blade, termed the single or male blade. The ring blade is introduced on the concave side, the single blade on the convex side, and pressure applied to the curved portion to press it into position. When this is done in the bony portion of the septum, the redundancy is accommodated by the impaction and crowding together of the fragments, if sufficiently comminuted by the forceps. If the deviation in the cartilaginous portion is large, it may be necessary to incise the cartilage obliquely in order

to overcome the redundancy by allowing the severed portions to overlap.

Submucous Resection of the Septum.

—This operation, which was first devised by Killian, of Freiburg, and afterward modified by Freer, Ballenger and others, has largely supplanted many of the older methods. Local anesthesia is employed. The nasal cavities should be thoroughly cleansed with an alkaline antiseptic solution and the mucosa thoroughly swabbed with a 1:1000 solution of adrenalin chloride to constrict the capillaries before the cocaine is applied. This decreases the liability to toxic effects from the cocaine. The mucosa is anesthetized by applying pledgets of cotton saturated with equal parts of a 10 per cent. solution of cocaine and a 1:1000 solution of adrenalin chloride. These are allowed to remain in place for fifteen minutes, after which powdered cocaine is rubbed into the entire mucosa by means of a cotton-wrapped applicator. A self-retaining nasal speculum is now introduced and a vertical incision made in front of the deviation on the convex side, beginning at the upper part of the septum and extending to the floor of the nose. The mucous membrane, perichondrium and periosteum of the corresponding side are then separated from the cartilage and bone by means of special elevators, which should be moved in an upward and downward direction in their long axis in order to prevent injury to the mucous membrane. This having been accomplished, a vertical incision is made through the cartilage to the perichondrium of the opposite side, following the line of the primary incision in the mucous membrane. A small elevator is then passed through the incision in the cartilage and the mucous membrane, perichondrium, and periosteum sepa-

rated as on the opposite side, great care being exercised in order to avoid injury to or perforation of the mucous membrane.

After the mucoperichondrium and periosteum have been separated from the septum on both sides, the Killian nasal speculum is introduced, one blade passing through the cartilaginous incision, while the other is placed beneath the membrane first elevated, which leaves the septum between the two blades, the mucous layers on the outside.

The cartilage is now removed either piecemeal with the cutting forceps, or preferably *en masse* with the Ballenger swivel knife. The next step consists in the removal of the deflected portions of the vomer, the perpendicular plate of the ethmoid and the maxillary ridge. This is accomplished by means of sharp-cutting forceps. In order to gain access to the maxillary ridge a sharp separator is often necessary for the purpose of separating the periosteum along the floor. The maxillary ridge is removed either with cutting forceps or the Killian chisel and a mallet. When all the cartilage and bone involved in the deviation have been removed, the field of operation is cleansed by douching with warm normal saline solution and the edges of the incision approximated. Both nasal cavities are packed with sterile gauze, or Bernays's intranasal tampons may be used.

The packing is removed at the end of twenty-four hours and the nose douched twice daily with normal saline solution, the patient being cautioned against forcibly blowing the nose. If the mucous membrane has not been injured the parts usually heal in a week or ten days.

FOREIGN BODIES IN THE NASAL CAVITIES.

Inanimate foreign bodies are frequently introduced into the nose by young children and insane persons. These consist of peas, beans, beads, buttons, fruit-stones, pebbles, coins, and, in fact, any object whose size will permit of its lodgment within the nasal cavity. In adults they occur as the result of external violence, such as gunshot wounds, explosions and similar injuries. Foreign bodies may also enter the nasal cavity by way of the nasopharynx, during vomiting, or sudden sneezing, or coughing during the act of swallowing. It sometimes happens that pieces of cotton or gauze are left in the nose and forgotten, later giving rise to trouble. Nasal plugs occasionally become pushed so far back in the nasal cavity that their removal is very difficult.

The symptoms are nasal obstruction, pain, epistaxis, sneezing, and a serous discharge. The affected side may be more prominent than the other, especially when such substances as peas, beans, etc., which have a tendency to swell, are present. These may even germinate. When the foreign body has been allowed to remain for any length of time, the discharge becomes mucopurulent and offensive, and abscess formation and necrosis of the cartilages and bones may occur.

When no history of a foreign body can be obtained, examination of the anterior nares with the aid of the probe will establish the diagnosis.

Removal is obviously the only treatment indicated, but this is not always easily accomplished, especially when the foreign body is imbedded in the

tissues and there is marked inflammatory reaction. The nasal cavity should be first sprayed with a 4 per cent. solution of **cocaine**, after which the object may be grasped with strong forceps and withdrawn. The introduction of the finger into the nasopharynx, for the purpose of pushing the foreign body forward, will often aid materially in its removal. When the object is round and smooth, so that it cannot be grasped with forceps, a small curette or hook may be passed beyond it and the foreign body drawn out. In some cases it is necessary to push the foreign substance into the nasopharynx and remove it by this route.

Animate foreign bodies, such as insects, maggots, and screw-worms, sometimes gain access to the nasal cavity, or the larvæ develop as a result of the deposition of the ova by certain flies. They give rise to severe inflammation of the nasal mucous membrane, with resulting pain, itching, and sneezing, accompanied by a bloody, purulent discharge and, frequently epistaxis. External swelling may also occur. These parasites may feed upon the tissues, causing an ulcerative process. The ulceration may not only involve the mucous membrane and underlying bone, but the inflammation may extend to the meninges and bring on a fatal issue.

These **parasites** or their **larvæ** should first be **killed** by the injection of a 50 per cent. solution of **chloroform**, after which they may be **removed** by means of the **nasal douche**, the **curette** or **forceps**.

RHINOLITHS, or nasal calculi, usually contain an inorganic foreign body as a nucleus around which the

salts are deposited and form a concretion. The symptoms are practically the same as those mentioned under inanimate foreign bodies. They can usually be **removed** with forceps, but if they are very large it may be necessary to first **crush** them with strong forceps **before** their **removal** can be accomplished.

NASAL NEUROSES.

SENSORY NASAL NEUROSES.

—**Anosmia**.—Loss of the sense of smell is infrequently observed, though its impairment through any local disorder is quite frequent. Mechanical obstruction of the nasal cavities by growths, especially nasal polypi, which prevents the odoriferous particles from coming in contact with the olfactory areas; inflammatory disorders of the nasal mucous membrane, acute or chronic, by causing infiltration of the tissues surrounding the olfactory fibrils, impair their sensitiveness and thus give rise to anosmia. Cerebral diseases of various kinds, cerebral tumors, locomotor ataxia, syphilis, lead poisoning, malaria, the excessive use of tobacco, the prolonged use of snuff, the constant inhalation of irritating fumes, etc., may be mentioned as among the many etiological factors of this disorder. The duration depends upon the cause; cases due to nasal growths usually recover their sense of smell soon after removal of the neoplasms, even though the latter may have been present a long time. Anosmia due to central disorders follows the course of the latter. **Measures calculated to remove the causative factors** are obviously indicated. Cases due to syphilis often promptly yield to **potassium**

iodide. **Strychnine** in full doses is of great benefit.

Cases not due to a destructive lesion are benefited, according to Sajous, by **strychnine**, $\frac{1}{40}$ grain (0.0016 Gm.), and **pituitarium**, $\frac{1}{40}$ grain (0.0065 Gm.), after each meal. Where syphilis, inherited or acquired, is suspected, **thyroid gland**, 1 grain (0.065 Gm.), should be added to each dose.

Hyperosmia.—Abnormal sensitiveness of the sense of smell is rarely observed, and is usually associated with hysteria, neurasthenia, hypochondria, menopause, and other conditions in which the nervous system is in a state of temporary or permanent adynamia. It sometimes occurs as an excessive physiological development, the sense of olfaction resembling that observed in some of the lower animals, especially dogs.

Parosmia (disordered or perverted sense of smell, the patient complaining of foul, peculiar, or pleasant odors) is a symptom occasionally observed in acute or chronic catarrhal disorders of the nasal cavities, sinus suppuration, syphilis of the nose, and of cerebral tumors when these directly or indirectly involve the olfactory bulb. It may also be due to infections and drug poisoning.

It often accompanies such neuroses as hysteria, epilepsy, insanity, neurasthenia, and locomotor ataxia, and is sometimes observed during pregnancy, the menopause and uterine disorders. Here also the cause must be ascertained and removed. Syphilitic parosmia quickly yields to **antispecific treatment**; but when it is due to cerebral tumors it follows the course of these.

Spasmodic Sneezing.—This represents but a manifestation of a physiological function repeated frequently or

continuing beyond the usual limits. It may be caused by an hyperesthetic state of the pituitary membrane coupled with the presence of foreign substances capable, by their shape, of keeping up a titillation of the epithelial surfaces. It may be caused reflexly through the eyes, by sunshine, pregnancy, the menopause, etc. The condition appears to be due to a temporary adynamia of the reflex centers. This is sustained by the fact that **tonics** and **stimulants** are usually beneficial.

Reflex Nasal Neuroses.—These are usually ascribed to an impulse starting from the termination of a nerve of the nasal mucous membrane through the intermediary of a sympathetic center, and giving rise to morbid phenomena at a point more or less distant from the nose. Epilepsy, neuralgia, facial spasm, etc., have thus been traced to nasal disease. Whether the peripheral nerve-filaments, the nerve-trunk, their ganglia, or the entire system is at fault is hardly determinable.

Reflex disturbances of the eyes are frequently observed as a result of hyperplastic rhinitis, atrophic rhinitis, polypi, etc. Cases of ciliary neurosis have been cured by division of nasal synechia. The connection between the nose and the eye mainly depends upon the branch of the ophthalmic division of the fifth nerve. Cutaneous disorders are sometimes ascribable to nasal disease, especially the group known as the angioneuroses, including urticaria, herpes, pemphigus, erythema, etc.

GEORGE F. DOYLE,
Philadelphia.

NOSE-BLEED. See EPISTAXIS.

NOVASUROL.—This preparation is described as a brand of *merbaphen*, chemically a double salt of sodium mercuri-o-chlorophenoxyacetate with diethylbarbituric acid. It is stated to contain 33.9 per cent. of mercury in a complex non-ionizable combination.

ADMINISTRATION AND DOSE.—The drug is commercially supplied in a 10 per cent. neutral and sterile solution, put up in ampules each affording a 1 c.c. (16 minims) dose. The drug may be given either intramuscularly or intravenously. According to Oerting, its intravenous administration is devoid of advantage.

The dosage ranges from 0.5 to 3 c.c. (8 to 48 minims), the average for diuretic purposes being from 0.75 to 2 c.c. (12 to 32 minims). The interval between injections for this purpose is from 3 to 7 days, depending on the effects and reactions. As an antisyphilitic the drug may be given in doses of 1 c.c. (16 minims), later increased to 2 c.c. if required. It can be administered in a single solution along with drugs of the arsphenamin group.

PHYSIOLOGICAL ACTION.—Novasurol induces a prompt and pronounced diuresis, which begins in about 2 hours after its injection and continues for 12 to 24 hours. Various theories of its mode of action have been offered, one being that, in part at least, there is a direct action upon the body tissues, with mobilization of H₂O and NaCl from the tissue spaces into the blood and an overflow of these substances from the blood into the urine. Another view is that the drug acts on the renal tubules, with resulting increased excretion. According to Crawford and McIntosh, there is a special sequence of events, as follows: (a) For the first 3 hours, hydremia; (b) then, a concentration of the blood, and (c) this, with direct renal stimulation, causes the later increased flow. Serby agrees with the conclusions of the foregoing authors, and notes that the stage of blood concentration reaches its peak in 24 hours, while changes in the blood nitrogen point to a renal action in the second phase of the diuresis. Serby also regards novasurol as a renal irritant, like other mercurials, and advises against its use in nephritis with nitrogen retention and lessened urinary output.

TOXICOLOGY.—An excessive dose, or even a small dose in susceptible individuals, may, according to Oerting, bring on such symptoms as headache, vertigo, nausea, vomiting, stomatitis, diarrhea, febrile reactions, and scarlatinoid eruption. The only reaction of consequence in his experience, however, has been diarrhea, which may go on to an acute colitis with mucus, blood and marked tenesmus. This is readily controlled with bismuth and paregoric.

THERAPEUTICS.—Novasurol was used originally as an antisyphilitic. In 1920 attention was called to its pronounced diuretic property by Saxl and Heilig. It has been found to be indicated especially in **cardiac decompensation with edema**, producing marked diuresis even where all the ordinary measures have failed. **Cardio-renal cases** with fair functional activity respond readily (Oerting), but the drug is contraindicated in edema of exclusively renal origin. Edema the result of syphilitic, rheumatic or sclerotic **valvular disease**, as well as of **myocarditis**, has been favorably influenced. The action has been best marked, according to Serby, in cases of decompensation accompanied by high blood-pressure and cyanosis. When it is employed with digitalis, each drug enhances the action of the other (Gilchrist). Novasurol is also advocated in the edema and **ascites due to cirrhosis of the liver**, the ascites of **peritoneal carcinoma**, and in **intrapleural exudates**.

Novasurol, of various diuretics tried, seemed to act best in **ascites complicating cirrhosis of the liver**, without impairing the general strength of the patient, and with comparatively little renal irritation. In an illustrative case, after a preliminary subcutaneous injection of 0.6 c.c. (10 minims), 9 injections totalling 12 c.c. (3 drams) were given at 4- to 6- day intervals, as a result of which the physical signs of fluid and the dyspnea disappeared. The patients receiving this drug must be watched for salivation and other mercurial symptoms, and a low water intake and almost salt-free diet should be insisted upon during the treatment. J. G. Anderson (Boston Med. and Surg. Jour., Dec. 31, 1925). S.

NOVOCAINE (PROCAINE).

—This widely used local anesthetic is chemically para-aminobenzoyldiethylaminoethanol hydrochloride: $\text{CH}_2-(\text{C}_6\text{H}_4.\text{NH}_2.\text{COO}).\text{CH}_2[\text{N}(\text{C}_2\text{H}_5)_2].\text{HCl}$. It occurs in small, colorless crystals or a white, crystalline powder, odorless and stable in the air. One Gm. of procaine hydrochloride is soluble in 0.6 c.c. of water and in 30 c.c. of alcohol, at 25°C . It is slightly soluble in chloroform, and almost insoluble in ether. The solution in water is neutral in reaction. From it the free base is precipitated if caustic alkalies or alkali carbonates are added; sodium bicarbonate can be added, however, without causing any precipitation or turbidity. Alkaloidal reagents such as potassium mercuric iodide and picric acid cause precipitation even in very dilute solutions of procaine. The drug is advantageous in that its solution may be heated to boiling without decomposition. Procaine hydrochloride melts between 153° and 156°C . It is official as *Procaine hydrochloridum*.

PHYSIOLOGICAL ACTION.—In its general effects when absorbed into the system, procaine resembles cocaine. A cardinal difference between the two, however, lies in their relative toxicity, procaine causing death only in doses 6 or 7 times as large as in the case of cocaine.

Locally, it acts like cocaine, exerting a prompt and pronounced anesthetic action. It is non-irritating, causing no after-pain, and has no tendency to cause, as does cocaine, tissue necrosis. According to J. F. Mitchell its action is somewhat slower than that of cocaine; in most cases, however, its less toxicity more than make up for this disadvantage.

Piquand and Dreyfus, with intravenous injections in rabbits, obtained the following results: Alypin, fatal dose per kilo., 0.017 Gm.; cocaine, 0.0183 Gm.; betacocaine, 0.019 Gm.; tropacocaine, 0.02 Gm.; stovaine, 0.03 Gm.; novocaine-epinephrin, 0.046 Gm.; novocaine, 0.063 Gm.

POISONING.—Only in rare instances are unpleasant secondary phenomena witnessed in the use of novocaine for local anesthesia. In administering 5000 injections of the drug, Fischer failed to note a single case of serious intoxication. In a few instances, however, an apparent idiosyncrasy has been observed, toxic manifestations such as rapid pulse, pallor, cold perspiration, and tremor being present. Occasionally a species of "hypnosis," with unconsciousness of the patient but retained ability to follow the operator's instructions, has been noticed. Faintness, vomiting shortly after injection, impairment of accommodation, headache, a feeling of warmth of the body, spasms, and paresthesias are among the commonest toxic effects.

According to Braun, 1.25 Gm. (20 grains) of novocaine can be injected without fear of intoxication, e.g., 250 c.c. (8 ounces) of a $\frac{1}{2}$ per cent. solution or 125 c.c. of a 1 per cent. solution. With a 2 or 4 per cent. solution, he considers it advisable not to exceed 0.8 Gm. (12 grains).

Small quantities of novocaine in weak solution injected into the region of large blood-vessels or spinal canal have been followed by death. While the drug is soon broken down in the blood stream, it must not enter the latter too abruptly. The safe amount of novocaine in general is not well established. Each person has a limit beyond which it is not safe to go. R. F. Carter (Current Researches in Anesthesia and Analgesia, Dec., 1925).

THERAPEUTICS.—Novocaine has achieved popularity as a local anesthetic mainly because of its low toxicity, and the fact that its solutions can be sterilized by boiling without deterioration. Balfour, of the Mayo Clinic, and others have reported uniformly satisfactory results from its use in various types of operations under local anesthesia.

A $\frac{1}{2}$ per cent. solution of novocaine is the weakest generally used, though Hoffmann and Kochmann affirm that by the addition of 2 per cent. of potassium sulphate the novocaine can be reduced to 0.1 per cent., and Gros asserts that upon addition of 1 part of sodium bicarbonate for every 4 parts of novocaine employed the anesthetic effect of the latter is at least doubled or trebled. Epinephrin (adrenalin, suprarenin, etc.) is generally added to solutions of novocaine in order to bring about vasoconstriction, the anesthesia being thus prolonged and the operative field rendered almost bloodless.

Solutions of novocaine-epinephrin may be prepared from tablets containing the two agents in the required ratio for the preparation of given amounts of solution. Such tablets, however, are not certainly sterile; boiling of the solution before use is therefore required, and since epinephrin preparations deteriorate upon boiling, it is preferable to make up a solution of novocaine in normal saline first (either from tablets or the crystalline drug), boil this solution, and finally add the required amount of a 1:1000 solution of epinephrin. Braun recommends that 1 c.c. (15 minims) of 1:1000 suprarenin solution be added, respectively, to 200 c.c. (50 drams) of $\frac{1}{2}$ per cent.

solution of novocaine, to 100 c.c. (25 drams) of a 1 per cent. solution, to 50 c.c. (12½ drams) of a 2 per cent. solution, or to 25 c.c. (6¼ drams) of a 4 per cent. solution. A dropper may be used to add the suprarenin solution, provided the number of drops required to make up 1 c.c. (15 minims) with the particular dropper used has been previously ascertained. A fresh mixture should be made before each operation.

Novocaine-epinephrin local anesthesia is available for a wide range of operative procedures, including many major operations. In the latter, solutions containing $\frac{1}{2}$ per cent. of novocaine are mainly used. The 1, 2, and 4 per cent. solutions are reserved generally for the anesthetization of single large nerve-trunks and for cases in which a rapid and intense action is required. The $\frac{1}{2}$ and 1 per cent. solutions can be employed almost *ad libitum*,—an advantage in that a wide infiltration of the operative field, with liberal blocking off of the sensory nerve supply, can be effected. Novocaine is not only suitable, however, for infiltration and nerve blocking, but is also used with success in terminal anesthesia (injection into or immediately under the skin). As for anesthesia of the mucous membranes, in rhinolaryngology 5 to 10 per cent. solutions may be employed, and for anesthesia of the larynx and pharynx, 10 to 20 per cent. solutions, with a small amount of epinephrin added; it is generally conceded, however, that for surface anesthesia novocaine is inferior to most other local anesthetics, its power to penetrate mucous membranes being relatively low. In dental practice, 1 or 2 per cent. novo-

caine solutions are successfully employed. The drug is also extensively used in spinal anesthesia (*q.v.*). The use of novocaine in intravenous anesthesia, as well as the manner of use of cocaine and other drugs in the production of local anesthesia in its various modalities, have been discussed in the article on COCAINE, to which the reader is referred for details not here presented.

In tests upon the addition to novocaine of various substances for the purpose of improving its action, true potentiation in surface anesthesia was observed only by the addition of alkali—either sodium or potassium bicarbonate. By this means novocaine can be made almost the equal of cocaine in mucous membrane anesthesia. Such a mixture should be given a trial in surface anesthesia of the eye, nose and throat, and urethra. In tests on anesthesia of the human tongue by immersion of its tip for 2 minutes in a solution containing 2 per cent. each of novocaine and sodium or potassium bicarbonate, the anesthetic effect equalled 2 per cent. cocaine. W. R. Meeker (*Jour. of Lab. and Clin. Med.*, Nov., 1925).

Various special uses of novocaine in local anesthesia are summarized by G. F. Bicknell as follows:

Frontal Sinus Operation.—Make a skin wheal over the suture between the nasal bones at their tips, another at the side of the nose at the same level, a third over the exit of the supratrochlear nerve from the orbit, one corresponding to the notch of the supraorbital nerve, one at the external angle of the eye, one about three finger-breadths above the last on the forehead, and the last in the middle of the forehead 3 inches above the root of the nose. Connect all wheals subcutaneously, using 1 per cent. novocaine solution. Now at the inner orbital angle introduce the needle along the inner orbital wall to a depth of $4\frac{1}{2}$ cm. and inject

2 c.c.; after withdrawing the needle about 2 cm. inject 1 c.c. more. The nasal mucous membrane is to be painted with 10 per cent. alypin-epinephrin solution.

Gasserian Ganglion Anesthesia.—

Introduce the needle opposite the alveolar process of the second molar tooth, patient's jaw being closed. Then, with the finger in his mouth, constantly avoiding the mucous membrane, guide the needle between the coronoid process of the inferior maxilla and the tuber maxillæ. Now incline the needle slightly upward and inward until it reaches the plate on the under surface of the sphenoid. At a depth of 6 cm. the needle engages the foramen ovale. When one strikes the region of the opening the patient has violent pain in the lower teeth. Now push the needle in $1\frac{1}{2}$ cm., when the patient will experience pain in the upper teeth; then inject 2 c.c. of a 2 per cent. solution of novocaine-epinephrin and anesthesia will be complete in a few minutes.

First or Ophthalmic Branch of the Trigeminal.—

Make a median orbital injection at a depth of $4\frac{1}{2}$ cm.; also inject along the lateral wall. The medial wall injection catches the ethmoidal branches; the lateral, the frontal and zygomatic nerves. Use about 2 c.c. of a 1 per cent. solution of novocaine on each side of the orbit.

Second Branch of the Trigeminal.—

Infiltrate with 5 or 6 c.c. of a 2 per cent. solution. Go in below the malar process to a depth of about 5 or 6 cm.; keep close to the tuber maxillæ and above the lateral tooth row. To make sure one is not in the internal maxillary artery, put on syringe and aspirate. A skull should always be besides the patient's head.

Third Branch of the Trigeminal.

—This may be blocked either at the foramen ovale by the same technique as for Gasserian ganglion anesthesia, or its mandibular branch may be blocked just before it enters the canal of the inferior maxillary bone.

Resection of Lower Jaw or Tongue.

—Give a hypodermic of morphine-

atropine or morphine-scopolamine. Block the lingual and alveolar nerves. From a midpoint just above the hyoid bone infiltrate the base of the tongue under guidance of the left finger placed in the mouth, thus blocking the ninth nerve and making the tongue and gums almost bloodless. Paint the pharynx with 10 per cent. cocaine to obliterate reflexes.

Operations on the Neck.—The most important part of the infiltration is along the posterior border of and through the sternocleidomastoid muscle down to the transverse processes. This, plus a thorough subcutaneous and subfascial injection encircling the area, gives an excellent anesthesia. From 50 to 60 c.c. of a $\frac{1}{2}$ per cent. solution should be injected along the posterior border of the sternocleidomastoid muscle. One needs from 120 to 130 c.c. for an operation.

If the floor of the mouth is to be included, block both linguals or inject the floor of the mouth from a central point above the hyoid bone.

Thyroidectomy.—Make a six-sided figure with one side corresponding to the posterior border of the sternocleidomastoid. One point should be over the middle line of the neck at the isthmus of the gland. Inject 50 to 60 c.c. along the posterior border of the sternocleidomastoid. Connect subcutaneously and subfascially all six points. Infiltrate under the isthmus. The vertical lines of infiltration are the most important, as they cross the nerves. One hundred to 150 c.c. are usually required for this operation, using 16 drops of adrenalin to each 100 c.c. of novocaine solution. Wait at least fifteen minutes before operating.

Glands of Neck.—Infiltrate behind sternocleidomastoid, form six-sided figure, and connect up all points around. Inject several lines across the direction of the nerves, thus connecting points up and down the neck.

Excision of Breast.—Begin in the axilla and completely encircle the breast subcutaneously with a $\frac{1}{2}$ per

cent. solution. Inject 3 to 5 c.c. in each intercostal space to block the intercostal nerve. Strongly abduct the arm and inject 40 to 50 c.c. of a $\frac{1}{2}$ per cent. solution of novocaine under the pectoralis major as high up as the first rib, to block the brachial plexus. Wait fifteen minutes for anesthesia.

Brachial Plexus Anesthesia.—Find the pulsating subclavian and make a skin wheal just to its outer side. Use a 4-cm. needle and pass it in the direction of the second or third dorsal spine. Pain in the fingers or elbow occurs when the plexus is struck. Inject from 10 to 20 c.c. of a 2 per cent. solution. The anesthesia reaches up to the middle of the upper arm and muscular relaxation occurs from the shoulder down. Use a Martin bandage because of undue congestion of the arm.

Sciatic Nerve.—Pass a finger into the rectum to palpate the nerve, and under this guidance pass a needle through the gluteus muscles directly into it. Upon injection of 2 or 3 per cent. novocaine, anesthesia is complete in from three to five minutes.

Fractures.—The injection of 20 to 30 c.c. of a 1 per cent. solution about the ends of the bones produces muscular relaxation and makes reduction painless.

Dislocation of the Hip.—Braun injects 25 c.c. of a 1 per cent. solution about the head of the bone, and 20 c.c., from close behind the anterior superior spine of the ilium, into the acetabulum. Reposition is easier than under narcosis.

Abdominal Wall.—Make subcutaneous and subfascial injections, then infiltrate under the peritoneum. If necessary one may infiltrate subperitoneally after the incision is made. One should make a large hexagon, so that if necessary the incision can be made larger. There is little danger of puncturing the intestine, for it slips away. Use 100 to 150 c.c. of a $\frac{1}{2}$ per cent. solution. Always precede with morphine-atropine or morphine-scopolamine.

Hernia, Inguinal.—Make the first skin wheal about two finger-breadths above the anterior superior iliac spine, infiltrating across the nerves toward the anterior superior iliac spine and also in the opposite direction. The second wheal is placed one finger-breadth below the middle of Poupart's ligament, the third wheal over the spine of the pubis, and the fourth internal to the ring. To complete the rhombus connect all wheals subcutaneously. Now inject deeply into the muscles and subfascially along these lines. From the first point inject subfascially downward to the outside of the external ring, and also to the inside of the external ring. Insert the finger into the canal and inject the structures that form it. Inject the spermatic cord with 5 c.c. (1¼ drams) of a 2 per cent. solution containing 5 drops of adrenalin 1:1000.

Keep on exerting steady pressure on the piston while injecting the cord to prevent injury to the pampiniform plexus. It usually requires from 100 to 150 c.c. (25 to 37½ drams) of a ½ per cent. solution to inject the field.

Hernia, Femoral.—Make a four-sided figure about the tumor, watching always the positions and relations of the larger vessels. The first wheal should be placed about two finger-breadths medial to the anterior superior iliac spine, the second over the spine of the pubis, the third over the junction of the middle and outer thirds of Poupart's ligament, and the last at the femoral opening. Connect all wheals subcutaneously and subfascially. From the second and third wheals inject about the neck of the sac, and from the fourth try to get under the sac. About 75 to 100 c.c. (19 to 25 drams) of a ½ per cent. solution are required.

Genitourinary Operations.—Local anesthesia for operations on the scrotum and testicle can be utilized in tuberculosis, syphilis, varicocele, and hydrocele, but is contraindicated in malignant disease where the gland

are to be removed. It is possible to anesthetize the whole external genitalia in the male. Make a wheal at the base of the penis, two lateral to it, and two or three on the perineum. Connect all wheals and inject the area where the scrotal skin joins abdominal skin.

The cord should always be injected separately with 5 c.c. of a 2 per cent. novocaine solution containing 5 drops of epinephrin 1:1000. For infiltration of the area about 100 c.c. are required.

Hydrocele.—Inject above and below the scrotal partition. Should the sac not be thoroughly anesthetized fill it up with novocaine solution and clamp opening for a few minutes.

Suprapubic Prostatectomy.—Make a hexagon on the abdomen and inject subcutaneously and subfascially down to the peritoneum. Inject 20 c.c. into the space of Retzius. Now inject, under the guidance of the finger, in the rectum 5 or 10 c.c. of a 1 per cent. solution between the rectum and prostate on each side, and, finally, fill the bladder with a 1 per cent. alypin-epinephrin solution.

Circumcision.—Put a constrictor at the root of the penis. Make four wheals and connect around the penis subcutaneously; then infiltrate down to the corpora cavernosa. Do not use too much fluid, as it might cause gangrene from fluid pressure. Do not use epinephrin. To amputate the penis use the above technique plus through and through injections of the corpora cavernosa.

Hemorrhoids and Fistula.—Make four or six wheals about two finger-breadths from the anal opening; connect these subcutaneously. To relax muscles and anesthetize mucous membrane make a cone of infiltration with the rectum as a center. Under guidance of the finger inserted inside inject deeply about the rectum. From 100 to 125 c.c. of a ½ per cent. solution are required for these purposes. In the course of the procedure the sphincters should not be widely dilated, but retractors used.

In anesthetizing fingers by Oberst's method a 1 per cent. solution of procaine is sufficient. Upon injection of a ring of the solution around the base of a finger or toes the part will become anesthetic in about 10 minutes. Combination of epinephrin with the procaine renders the use of a constricting band at the root of the member unnecessary.

In infiltration anesthesia 5 to 30 minutes should be allowed to elapse before the operation is begun. Where procaine solution is injected directly into nerves the anesthesia is not at its height for 10 to 15 minutes. The duration of procaine anesthesia, without epinephrin, is about 15 minutes; with epinephrin, about 2 hours.

Sacral anesthesia with novocaine is an excellent procedure for operative obstetrics, although its value for spontaneous delivery still remains to be proven. The writer uses 0.3 c.c. (5 minims) of 1:1000 adrenalin solution to each 40 c.c. (10 drams) of 1½ per cent. novocaine solution. Of this mixture he injects 30 to 35 c.c. (8 to 9 drams) epidurally through the sacral hiatus. Such anesthesia is relatively safe, Zweifel having been able to collect but 10 fatalities in over 4000 cases, in only 3 of which could the anesthetic be held responsible. No mishaps have been recorded in doses of 0.4 or 0.5 Gm. (6 to 7½ grains). The method has no influence upon the child. Many of the patients complain of feeling a little queer immediately after the injection. Usually there is little change in blood-pressure. Seventy of 103 cases had excellent anesthesia. The most constant feature is the marked relaxation of the perineum and cervix and the absence of pain. Tonicity of the fundus persists. The height of the line of demarcation between the tonic and atonic portions of the uterus varies somewhat in different patients. The relief from pain is complete whether

the uterus contracts or not. In the majority, there is cessation of contractions, or at least diminution of their force, for 20 to 60 minutes after the injection. L. P. Rucker (*Amer. Jour. of Obst. and Gyn.*, Jan., 1925).

A 0.5 per cent. novocaine solution is used in local anesthesia by the writer. The solution should be fresh and of accurate strength. Except in operations on toxic goiters and in areas supplied by terminal vessels, 5 minims (0.3 c.c.) of 1:1000 adrenalin chloride solution are added to each ounce (30 c.c.) of novocaine just before use. This amount of adrenalin is added to each of the first 3 ounces of anesthetic solution, so that the maximum dose of adrenalin is 15 minims, regardless of the amount of novocaine used. Either tablets of novocaine and suprarenin or sterile ampules of adrenalin chloride may be used. No untoward effects from novocaine have been observed by the writer, even when using as much as 8 ounces (240 c.c.) of 0.5 per cent. solution, in an experience covering operations of every possible type. The toxic effect of novocaine may manifest itself in nausea, vomiting, cardiac palpitation, dizziness, and cold sweat. The toxic action is usually cerebral in origin. Occasionally persistent nausea and vomiting occur. If fresh air and cold cloths to the forehead do not relieve the condition, a few whiffs of ether, carried on to complete narcosis if necessary, are indicated. C. F. Nassau (*Atlantic Med. Jour.*, May, 1925).

Internally, novocaine may be used for local analgesic purposes in doses not exceeding 7½ grains (0.5 Gm.).

C. E. DE M. SAJOUS

AND

L. T. DE M. SAJOUS,
Philadelphia.

NUCLEINIC ACID. See NUCLEINS.

NUCLEINS.—Nuclein is the principal protein found in the nuclei of the

cells of plants and animals or of yeast. It is an amorphous substance rich in phosphorus. On boiling with alkalis phosphoric acid is set free. Physiologically, nucleins may be said to form the chief chemical constituents of the living parts of cells. The number of kinds of nucleins is limited only by the varieties of cells. Chemically, the nucleins are complex protein bodies characterized especially by the large amount of phosphorus they contain. The phosphorus exists in the form of nucleic acid, which is combined with a highly complex basic substance, the nucleic acid of all nucleins being the same, but the basic portion differing in the various nucleins. The basic substance, on decomposition, yields one or more of the xanthin bodies.

The nucleins in general are insoluble in dilute acids and soluble in dilute alkalis; hence they resist peptic digestion and in this way may be separated from most other protein bodies.

Certain substances, histologically and functionally nucleins, do not yield any xanthin base (adenin, guanin, sarcin, xanthin) as a decomposition product. These are called *paranucleins*. Some of these are the antecedents of true nucleins. Some nucleins are combined with albumins, forming compounds known as nuclealbumins. When one of these bodies is submitted to peptic digestion, the albumin is converted into a peptone, and the nucleins form an insoluble precipitate (Vaughan).

The nucleins may be obtained from many sources—from yeast, casein, the nuclei of blood- and pus-corpuscles, the liver, the spleen, bone-marrow, the thyroid and thymus glands, the testicles, the brain, the cells of plants and grains, or any structure containing numerous cell elements.

PREPARATIONS AND DOSES.—While no preparation of nuclein is official, there are on the market several which may be used. These are variously *thymus* (Parke, Davis & Co.) or *spleen nucleins*; a proprietary known as "*protonuclein*" (Reed and Carnrick); a *nuclein solution* for internal use containing 5 per cent. of nucleic acid from yeast; a *special solution* of nuclein, also 5 per cent., for hypo-

dermic use; a *sodium nucleinate*, a yellowish powder prepared from nucleic acid of yeast (Merck). It is readily soluble in water. There is also a *sodium tritico-nucleinate* derived from the wheat germ. The dose varies according to the process of manufacture. The dose of nuclein, nucleinates and nucleic acid is from 8 to 15 grains (0.5 to 1 Gm.).

PHYSIOLOGICAL ACTION.—The most prominent action of nuclein or nucleic acid is believed to be stimulation of glandular activity with increase of polymorphonuclear leucocytes. Germicidal properties have been attributed to it. The pulse is increased in frequency, as a rule, within 3 to 5 hours, the temperature rising concurrently about 1° F. The phosphorus content of the urine is increased, the absorption occurring mainly from the intestine through the action of the pancreatic juice.

According to Aschernorurzki, nucleic acid injected into the animal organism exercises a distinct influence upon the zymotic power of the cells. This action is more marked after intravenous than after subcutaneous administration. The amylolytic ferments are most markedly influenced. In the brain of animals treated with nuclein the amylolytic power was increased 400 times; in the lungs, 250 times; in the muscles, 6.4 times; in the thymus, 2.5 times. Sodium nucleinate administered continuously, and often in enormous doses, to animals was not found by this investigator to exert any harmful action.

THERAPEUTICS.—Nuclein has been used with apparent benefit in **septicemia**, in **tonsillitis** and **pharyngitis**, in **pseudodiphtheria**, and as a dressing and injection for **indolent ulcers**. It was used successfully in a case of **progressive anemia** in which all the other remedies used had failed.

In cases of **diphtheria**, **scarlet fever**, and **measles**, the injection of a nuclein solution has been asserted to abort the attack and quell the complications. **Hip-joint disease** is sometimes improved by the systematic use of nuclein injections every second day (Hitchcock). It has been used apparently with profit in **paralytic disorders** due to suboxidation, and also in **periodical insanities**.

In several psychoses, J. Lépine obtained good results from injections of sodium nucleinate. The dose generally used was 50 c.c. of a 1 to 5 per cent. solution. The effects were especially favorable in acute and subacute mania and in periodic insanity. In dementia precox and degenerative delirium they were also satisfactory.

In 70 per cent. of paralytic patients in whom Donath gave injections of a 2 per cent. sodium nucleinate solution there was decided improvement; in 50 per cent. the patients were able to return to work. The injections were given at intervals of 5 to 7 days. On an average 8 treatments and 8 Gm. (120 grains) of sodium nucleinate were required. The following solution was used:—

Sodii nuclein. gr. xxx (2 Gm.).

Sodii chloridi gr. xxx (2 Gm.).

Aq. dest. steril. . . . 3iii½ (100 c.c.).

On the whole, the use of preparations of nuclein has greatly diminished in late years. In gouty subjects their administration is contraindicated.

S.

NURSING AND ARTIFICIAL FEEDING.—BREAST-MILK.—

Physical Properties.—Breast-milk is slightly bluish and opalescent; it is sweet, amphoteric to litmus, slightly acid to phenolphthalein. Under the microscope are seen fat-droplets and granular matter; if milk from the colostrum period is examined, there are also epithelial cells and leucocytes undergoing fatty degeneration,—"colostrum-corpuscles,"—and the fat-droplets are found of varying sizes.

The colostrum furnishes to the newborn protective antibodies which probably add much to its capacity to resist infection in early life. The blood of the newborn is devoid of the serum protein known as *euglobulin*, which seems to be supplied by the colostrum, and is unique in its association with the immune bodies of the blood. J. H. Lewis and H. G. Wells (Jour. Amer. Med. Assoc., Mar. 25, 1922).

Chemical Composition.—The nutritive ingredients are:—

1. WATER, constituting from 85 to 90 per cent.

2. FAT, in the form of minute globules held in emulsion by the soluble protein. If the milk stands, the fat collects at the top as cream. In a good specimen the percentage varies from 3 to 5, the average being about 3.5. The fat is made up chiefly of neutral fats, olein, palmitin and stearin, the olein predominating. Small amounts of fatty acid, chiefly the lower or volatile forms, are present.

3. SUGAR.—The carbohydrate of breast-milk is lactose, or milk-sugar. Its proportion is remarkably constant: 6 to 7 per cent. during the whole nursing period.

4. PROTEINS.—Casein and lactalbumin are the principal forms. The lactalbumin is in solution, and is the more readily digested and absorbed; its amount is about twice that of the casein. The casein is in suspension, and is readily precipitated; the curd formed by adding acetic acid to breast-milk is in fine flocculi, thus differing from that of cows' milk, which comes down in dense masses. In a good specimen the proteins vary from 1 to 2 per cent., the average being about 1.25 per cent. In abnormal specimens the variations range from 0.7 to 4.5 per cent.

5. SALTS.—The most important salts are calcium phosphate and potassium carbonate. Altogether the salts amount to about 0.2 per cent.

The calcium content of breast milk was studied quantitatively by the writers. They found the average of "normal" milks to be 32.6 mgm. per 100 c.c., with extremes of from 23.7

to 40.0 mgm. The "rachitic" milks averaged 27.5 mgm., with extremes of from 18.4 to 39.6 mgm. When milks were grouped according to the age of the infant, the calcium content decreased as lactation progressed. The calcium content of milk from the white race was higher than that of the colored race. DeBuys and von Meysenbug (Amer. Jour. Dis. of Childr., May, 1924).

CLINICAL EXAMINATION.—

While a complete chemical analysis of the milk is desirable, this is often impossible; and the physician must depend on his own simple tests.

The **quantity** may be estimated from the amount which can be drawn with a breast-pump; but the most reliable test is to weigh the infant before and after nursing, on scales sensitive enough to record differences of half an ounce. The average result of two or three such weighings will be sufficiently definite.

The **quality** of the milk, or, at least, **whether very rich or very poor**, can be estimated by the following procedures:—

Development of the Breasts.—

Breasts rich in glandular elements secrete the best milk. The conical breast which is not very large, and has but little fat, is usually the best form.

Number of Childbirths.—This has an influence only in so far as it affects the general health of the woman. The milk is apt, however, to give out earlier with each successive lactation. Nevertheless, frequently a mother may have been unsuccessful in nursing her first and even second baby and succeed admirably with a later one.

Acute Illness.—If mild and of short duration, there is no lasting effect; if

severe and prolonged, the milk is reduced in quantity, the fat becomes low, and the proteins often high. In septic and suppurative disease bacteria may be found in the milk.

Diet.—A generous diet increases the fat and the proteins. A nitrogenous diet, consisting largely of meat, milk, eggs, beans, peas, etc., increases the fat more than the proteins; but, if the nurse takes little exercise, there is apt to be an excess in the proteins also. Large quantities of liquid increase the amount of milk; but the percentage of solids is diminished. Malted drinks increase the quantity, and raise the proportion of fat. If the diet is low, the milk becomes scanty, the fat is diminished, and the proteins usually diminish; if increased, they are often changed in character. No matter what the diet, the percentage of sugar remains practically unchanged.

Drugs.—Only a few drugs are with certainty eliminated by the breast, and these in varying proportions. Alcohol, opium, atropine, chloral hydrate, phenobarbital, and the iodides may be given off in an amount sufficient to cause symptoms in the nursing; likewise rhubarb, senna, castor oil, and the saline cathartics. Occasionally the salicylates, copaiba, colchicum, antipyrin, turpentine, iron, and arsenic are eliminated in appreciable quantities. Mercury is excreted only in very small amount, after prolonged administration.

Toxic symptoms observed in a 17 days' old baby, nursed by its mother who had been poisoned by mushrooms (*Amanita phalloides*). Experiments on guinea-pigs made the transmission of the poison by the milk very probable. Bittenwieser and Bodenheimer (Deut. med. Woch., May 9, 1924).

For a few days previous to and after parturition an epileptic woman was given 0.1 Gm. ($1\frac{1}{2}$ grains) of luminal (phenobarbital) 3 times a day. The newborn infant seemed normal, but then became gradually more and more sleepy. This condition passed off when the mother ceased taking the drug. Frensdorf (Munch. med. Woch., Feb. 19, 1926).

Exercise.—The quantity of the milk is usually increased, and the proteins diminished, by moderate exercise.

Nervous and Emotional Disturbances.—There are few influences that affect the milk so immediately and so strikingly as nervous impressions. Grief, anger, fright, passion, great excitement, and fatigue are apt to have a prompt and decidedly bad effect, so that the infant may be actually poisoned, and have an attack of severe acute indigestion, which may be accompanied by convulsions. The change in the milk is probably in the proteins, toxic nitrogenous bodies being formed. The specimen taken for examination should be the entire amount of milk that can be pumped from one breast.

Estimation of the Fat.—A cylindrical glass tube, holding 10 c.c. and graduated to hundredths, is filled with breast-milk and allowed to stand at ordinary room temperature for twenty-four hours. Then the percentage of cream is read off. Under such conditions the percentage of cream is to that of fat approximately as 5 to 3; thus, 5 per cent. of cream indicates 3 per cent. of fat, etc. Accurate results may be obtained by the Babcock test or by Lewi's modification of the Leffman and Beam test for cows' milk.

Estimation of the Proteins.—So far as the proteins are concerned, it is

possible to distinguish only between conditions in which they are very high and very low. The sugar and salts are present in so nearly constant proportions that their variations may be regarded as having practically no effect on the specific gravity. If, then, the fat is high, and the specific gravity is high, the proteins may be assumed to be in excess; if the fat is low, and the specific gravity low, the proteins may be assumed to be in too small proportions.

For the simple clinical examination of breast-milk a lactometer and a graduated tube suffice. The milk examined is either the entire specimen at a single nursing or a specimen taken as near the middle of the nursing as possible. The specific gravity is first taken; then the milk is put into a graduated tube up to the 100 line, and allowed to stand for 24 hours, at which time the amount of cream which has risen can be read off as hundredths. A good average milk has a specific gravity of about 1030, with about 8 per cent. of cream. If the specific gravity and cream percentage do not vary materially from these figures, it may be inferred that the amount of proteins is normal.

Bacteria.—No germs are found in normal human milk if the skin of the breast has been cleaned and the first drawings have been discarded. Only in case of suppurative or tuberculous disease of the breast or some general microbic disease does the milk in the lobules contain bacteria.

Practically, the final test of the breast-milk is its effect upon the baby. The milk may be perfectly normal, so far as can be determined by chemical analysis, and yet may disagree with and even poison the baby. If there

has been a careful effort to adjust the quantity given at each feeding and the intervals of the nursings to the baby's comfort, and indigestion persists, it is necessary either to modify the breast-milk by giving the baby barley-water before the nursings or to change to another wet-nurse or to bottle food.

Elimination of Antitoxin and Other Protective Substances.—Diphtheria antitoxin is eliminated in the milk of immunized animals, and the Widal reaction may be obtained with milk of patients suffering from typhoid fever and with the blood of their healthy nursing infants. It is probable that other protective alexins are eliminated by the mammary gland.

CONDITIONS WHICH AFFECT THE COMPOSITION OF BREAST-MILK.—**Age and Constitution of the Nurse.**—The milk of a woman between 20 and 35 years is richer in fat than at other ages. Moreover, a robust constitution contributes to an abundant milk-supply; still, many delicate-looking women make good nurses.

Menstruation.—Comparatively few infants are very much affected by the return of menstruation. The quantity of the milk is often diminished and its quality impaired for the first day or two of the menstrual period.

Pregnancy.—If pregnancy supervenes, the milk deteriorates steadily in quantity and quality.

NURSING.—"Will the mother be able to nurse the baby?" is a question the physician must frequently answer nowadays when an infant is born.

Irrespective of any good explanation, it is a fact that each year there are fewer women that can nurse their

babies. In some conditions nursing is either impossible or inadvisable; in others the question can be answered only after a trial.

There is no question that the ability to nurse an infant successfully is to a large extent a matter of inheritance. It is probable that a line of mothers who, though able, practise voluntary refusal to suckle their offspring finally develop an acquired characteristic which can be transmitted, resulting in inability in the mothers of the younger generation to perform the maternal function of nursing. J. P. Crozer Griffith (*Med. Rec.*, Sept. 21, 1918).

The excessive advertising of patent foods and dried milks is responsible for a large part of the neglect of breast feeding. The mother who reads these advertisements gains the impression that natural feeding is unnecessary. The normal infant may tolerate even unsuitable artificial feeding, but he is apt to present later disturbances due to the faulty diet, while the delicate child is definitely injured. That failure to nurse may be due also to lack of knowledge on the part of physicians and nurses is evident from the great decrease in infant mortality rate since the institution of infant welfare centers under the guidance of trained physicians and dietitians. Probably 95 per cent. of mothers are able to nurse their infants wholly or partially. Jewesbury (*Arch. of Ped.*, Feb., 1923).

A comprehensive study based on over 26,000 infants in various states showed that the mortality rate among artificially fed infants is at least 3 to 5 times as high as among breast fed. Among artificially fed infants it is also higher than in those partially breast fed. Among the partially breast fed, it is higher than among the breast fed up to the 8th month. The longer the period of breast feeding, the lower the infant mortality. Mortality rates are higher for all causes of death among the artificially fed than among the breast fed, and

much higher for gastroenteritis and respiratory diseases. The many reasons given for weaning indicate that in a large number of cases it is unnecessary. F. L. McKay (N. Y. State Jour. of Med., Mar. 28, 1924).

Conditions in which Nursing Should Not be Attempted.—1. If there is no milk secreted.

2. If tuberculosis is present in any form.

3. If there is malignant disease of the breast, or if there have been serious complications of parturition, as hemorrhage, eclampsia, nephritis, or septicemia.

4. The presence of chorea, epilepsy, or insanity precludes nursing.

In the above-mentioned conditions nursing is deleterious to both the mother and the child.

Maternal nursing may be reestablished, according to Wile, through the regular suckling of an infant, even though several months have elapsed since the breasts were used for this purpose. Jacobius has been able to have women nurse their infants even where they have not done so at all for periods of three to twenty-six days after delivery.

In spite of the apparent absence of *Spirocheta pallida* in the milk of syphilitic women, Uhlenhuth and Mulzer induced syphilitic lesions in rabbits by inoculations with milk from 8 syphilitic parturients. Microscopically the milk was sterile. In one of the positive cases the woman was free from symptoms of syphilis, but her child had signs of the disease. Research on gastric juice showed that it rendered the spirochetes non-motile in a few minutes.

The author is strongly opposed to breast nursing of apparently healthy children by syphilitic mothers. The mother might transmit the disease and a wet nurse get infected from the baby if it should prove syphilitic. M. Hesse (Wien. klin. Woch., May 8, 1924).

During maternal illnesses the continuation of breast feeding varies with

the nature of the affection. The writers continue nursing in puerperal affections, but as the quantity of milk decreases, mixed feeding has to be used in addition. Only in puerperal sepsis is breast feeding suspended. Tuberculosis of the mother is a strict contraindication for nursing. Runge and Lauer (Deut. med. Woch., May 9, 1924).

Conditions in which Nursing is Not Likely to be Successful.—1. If, on previous occasions, under favorable conditions the mother has been unable to nurse.

2. When the woman is of a very delicate constitution and highly nervous.

If nursing is attempted in these circumstances, the baby's weight and general condition should be carefully watched. The usual custom is to continue nursing as long as the infant thrives, but the mother's condition should be watched with equal solicitude, lest she be injured by continuing the nursing too long.

CARE OF THE NURSING WOMAN.—Diet and Mode of Life.

—The nursing woman should have a generous **mixed diet**, not excessive in nitrogenous food nor in vegetables. She should drink from a quart to a quart and a half of milk or milk-gruels daily. Meat, eggs, such cereals as oatmeal, rice, hominy, etc., bread, potatoes, all the common vegetables, and fresh fruits are allowed. Very highly seasoned foods, salads, cabbage, tomatoes, stale or unripe fruits, alcoholic drinks, strong tea, and coffee are forbidden. Whatever disturbs the mother's digestion is apt to produce a bad effect upon the milk, and should therefore be avoided.

The mode of life should be **simple**, with **regular exercise**,—by motoring,

early, or by walking, later, as soon as returning strength will permit. There should be **no anxieties nor great excitement.**

Breasts and Nipples.—At least a month before confinement the **nipples** should be examined, and, if flat or depressed, they should be **drawn out** and the woman instructed to do this herself several times a day. If the nipples are hard, **borated vaselin** or **lanolin** should be rubbed on them four or five times daily; if soft and macerated, they should be painted three times a day with equal parts of 50 per cent. **alcohol and glycerin.**

During the whole of lactation the nipple should be cleansed with 2 per cent. **boric acid solution** before and after nursing, and the **breasts supported** in a well-fitting corset. Slight excoriations are well treated by dusting them freely after each nursing with **bismuth subcarbonate**; for fissures probably the best treatment is to paint with an 8 per cent. **silver nitrate solution** once or twice a day, and either to use a **nipple-shield** or **stop nursing for a time from the affected breast.**

It is necessary, in the majority of cases, to use nipple-shields because of the small size of the nipples as well as because of fissures.

NURSING RULES FOR HEALTHY INFANTS.—Regular hours are very important, and should be adhered to from the beginning. This practice will do much to establish regular habits of sleep and regular movements of the bowels. If the child is asleep it should not be allowed to go beyond the regular nursing time for more than half an hour, but be awakened. From the outset, moreover, the infant should take **boiled**

water from a bottle at least once a day, not only for the purpose of ingesting the water, but also to learn to use the **rubber nipple.**

It is generally not necessary to put the child to the breast until three or four hours after birth; and even then it should be allowed to nurse only about five minutes. Aside from the fact that the breasts contain little milk until the third day, the nipples should be gradually accustomed to their function. After the second day the child may nurse from ten to twenty minutes.

The importance of nursing slowly, in particular as regards young infants, emphasized. The newborn infant, fast asleep for some days, then becomes so hungry that he gulps down his food. This habit, if unchecked, soon leads to colic, indigestion, and sometimes malnutrition. To remedy this, the mother may pinch the nipple at regular intervals or withdraw it after each mouthful, giving the baby time to breathe, cry and rest. After one week of this, all symptoms rapidly disappear, whether the baby is breast or bottle fed. Ostheimer (Penna. Med. Jour., July, 1922).

The number of nursings a healthy infant should have in twenty-four hours, together with the intervals and the number of night-nursings, are given in the subjoined tables.

SCHEDULES FOR BREAST AND ARTIFICIAL FEEDING.

A

Age.	Number of Nursings in 24 Hours.	Intervals Day and Night.
First day	3 to 4	4 hours
First 5 weeks	6	4 hours
Five weeks to 10 months	5	4 hours to 10 P.M.
Ten to 12 months	4	4 hours to 6 P.M.

B

Age.	Number of Nursings in 24 Hours.	Intervals, Day.	Intervals, Night.
First day	4 to 5	3 hours	4 to 5 hours
First day to 2 or 3 weeks	7	3 hours	4 to 5 hours
2 or 3 weeks to 5 weeks	6	4 hours	4 hours
5 weeks to 10 months	5	4 hours	4 hours to 10 P.M.
10 to 12 months	4	4 hours	none

Schedule A is preferable and should be tried in all cases unless contraindicated. Contraindications are: Small capacity of the infant's stomach, in which event it must take less in quantity at shorter intervals, and premature infants. Rarely is it necessary to shorten the intervals to aid in increasing the secretion of milk. If the infant does not empty the breast, this should be done by "expressing" or by means of the electric breast pump.

Schedule B is used when it is thought desirable to nurse every 3 hours for the first 2 or 3 weeks. Its use should be infrequent, and the 4-hour intervals started as soon as possible.

An infant that is "mechanically" satisfied with water will not want to nurse. Water must be supplied in sufficient quantity, but not in excess. Too little fluid, *i.e.*, not enough water or milk, will result in "inanition fever." If the infant during the first few months of life requires from 2 to 2½ ounces of fluid per pound of weight, then 2 or 3 ounces of water daily is theoretically not enough. This may be continued only for the first 2 or 3 days, to encourage the infant to take the breast. After this, more fluid, milk or water or both, should be given.

An infant that does not take the required amount of milk necessary for

a gain in weight should be fed with a teaspoon, medicine dropper or Breck feeder until the desired amount of breast milk (which has been "expressed") or artificial food has been given.

The 4-hour feeding interval was adopted to meet the needs of certain conditions, such as tenderness of the nipples or over-rich breast milk, as well as to give the mothers more freedom. The author considers such a long interval injurious, however, in the premature infant, and also in the sluggish or weak infant, who does not nurse vigorously enough to obtain sufficient nourishment from 5 daily nursings, as well as in mothers whose milk is insufficient unless stimulation is more frequent. Southworth (*Arch. of Ped.*, Feb., 1922).

SIGNS OF SUCCESSFUL NURSING.—The following are the important features to be considered:

Weight.—All infants should be weighed once a week, and feeble infants twice a week during the first six months. A loss in weight during the first three or four days is normal, and amounts to about one-tenth of the infant's birth weight. After about a week the regular gain for the first five months should be about 6 ounces per week; from the sixth month to the end of the first year there should be an average gain of from three-fourths of a pound to a pound per month. At five months the average healthy infant should have doubled its birth weight, and at one year should have trebled it. It is to be noted that the gain during the second six months is more apt to be irregular, due to dentition, end of lactation, etc.

In 100 observations by the method of fractional weighing of the nursing infant at 2-minute intervals, it was found that infants obtain 40 to 60 per cent. of their feeding of breast milk

in the first 2 minutes, and 60 to 85 per cent. in the first 4 minutes. This holds true whether the supply is abundant, moderate, or scanty. When the breast supply is evidently failing, the baby gets all he can in 3 to 5 minutes. The method of fractional weighing may well be applied to every breast-fed baby, since it is the only way to determine how long a given baby should nurse, and whether he needs both breasts. The writers assume a good feeding to be one in which a baby gets at least 0.33 to 0.4 ounces per pound of body weight. C. H. Smith and K. K. Merritt (*Amer. Jour. Dis. of Childr.*, Nov., 1922).

In normal children, the birth weight, averaging 7.1 pounds, is doubled in 164 days. In small children, the birth weight, averaging 5.3 pounds in the writer's series, is doubled in 112 days. All groups of children showed a minimum rate of gain at about 6 months. The more rapid gain after this time is ascribed to supplementary food. J. A. Höjer (*Acta ped.*, v, 59, 1925).

Not only should the child gain in weight, but the flesh should be firm, and the cheeks, ears, and lips of good color.

Length of Time and Manner of Nursing.—The infant should always be ready to nurse at the proper time, but not overgreedy; and it should be satisfied after nursing ten, or at most twenty, minutes. Satisfaction is shown by relinquishing the breast voluntarily, and then either falling asleep or remaining contented and happy while awake.

As remarked by Merklen, the crying of the infant when it does not get enough food at a meal, its restlessness and its gradual exhaustion and dropping to sleep, make a picture which is very different from the fatigue and slumber of the well-fed, healthy child. Even during its sleep the child is still restless, and it whimpers at times, while the slightest noise rouses

it, when it appeals anew for the nourishment it needs without having the strength to make its appeals very insistent. There is also a marked tendency to false constipation, not enough food being obtained to make normal stools, while the walls of the intestine, suffering from lack of nourishment, become too weak to move the feces along.

Vomiting.—There should be no true vomiting; but there may be regurgitation of small quantities of milk almost immediately after nursing,—due usually to overdistention of the stomach, or to the eructation of swallowed air. To prevent this, the baby should be **held over the shoulder in the midst of or immediately after the nursing** and then be put in a **semi-reclining position** or even **lying on the face**. This permits the gas and swallowed air to escape from the stomach.

Occasional regurgitation in infants is physiologic, but habitual regurgitation indicates that the child is getting too much food. Breast fed children are the ones that present it most frequently, as they can tolerate overfeeding longer. Repeated hiccupping also indicates that even if the food is well digested, the child is getting too much. Excessive drooling has the same significance. Moderate drooling may occur because the infant does not know how to swallow saliva. It may accumulate in the mouth and throat and make the breathing noisy, suggesting stridor, etc. Up to the fourth or fifth month very little saliva is secreted. After this, coryza or adenoids may force the child to keep its mouth open and all the saliva may drool out. Marfan (*Nourisson*, Jan., 1919).

Stools.—There should be from one to three easy, natural movements daily; soft, smooth, and free from large or hard curds. The presence of soft yellow or soft white curds in healthy nursing infants is so common

that it must be regarded as within the range of normal. Similarly the appearance of green stools is usually due to a change in the bile coloring matters from fermentation of the sugar. Moreover, many stools that were yellow on being passed turn green if left in the diaper for some time. After the disappearance of the meconium, about the fifth day, their color should be light orange or yellow. Normally their reaction is acid.

During the first few weeks of life the infant has from 3 to 5 loose golden-yellow stools daily. Gradually after this time the stools become fewer in number and of a salve-like consistency, so that at about the third month they are reduced to 2 or 3 daily. The color is due to bilirubin. The reaction is acid, due to the relative excess of fat over protein in the milk. Sometimes the stools are brown in color; when this is the case, the milk was relatively high in proteins. The presence of small curds and a small amount of mucus in breast-fed infants' stools does not usually interfere with an infant's gain in weight and comfort. Weston (Med. Record, Jan. 20, 1917).

Sleep and Disposition.—During the first few weeks infants should sleep nearly all the time they are not nursing; at six months considerably more than half the time; and from then on until a year old they should take both a morning and an afternoon nap.

It is normal for a baby to cry from fifteen to thirty minutes daily; but fretfulness, peevishness, and sleeplessness, with crying, are abnormal conditions.

Development.—With successful nursing there should be the signs of normal healthy development. In the muscles this is shown by the child hold-

ing up its head at the fourth month or earlier, sitting with the back unsupported at the eighth month or earlier, standing by the ninth month, and beginning to take steps by the end of the first year.

Dentition should be regular, the lower central incisors appearing before the ninth month, and the upper incisors before the end of the year.

SIGNS OF UNSUCCESSFUL NURSING.—**Temperature.**—During the first four or five days the most important sign of insufficient food is a rise of temperature: "inanition fever," so called. It is probably due essentially to lack of fluid, since infants that receive plenty of water do not show it. The range may be from 101° to 102° F. (38.3° to 38.9° C.), or in extreme cases from 104° to 106° F. (40° to 41.1° C.). If no obvious symptoms of illness are present, such a temperature before the fifth day may be regarded as due to inadequate nursing.

Weight.—Failure to make the proper gain, if not accounted for by existent disease, is nearly always due to inadequate nourishment.

A prime factor in milk secretion is preservation of a normal psychic state. With an insufficient supply, supplemental feedings should be tried. Sometimes even this may be avoided by nursing from both breasts at one feeding. J. P. Crozer Griffith (Med. Record, Sept. 21, 1918).

Stress laid on the value of **expression of the milk** as a factor in maintaining the supply. The technique does not consist in going over the whole gland tissue and using massage, but simply in emptying the sinus back of the colored areola. The procedure is especially indicated for premature infants or where for any reason, such as inverted, fissured, or sore nipples, the infant cannot take the breast. Sedgwick (Med. Rec., Sept. 4, 1920).

Length of Time and Manner of Nursing.—If the infant habitually remains at the breast for more than twenty minutes; or if, after taking the breast with avidity, it soon turns away fretting, only to resume in a minute or so, and finally gives it up disgusted and crying, the milk is probably too scanty. Sometimes the same thing is indicated by the baby refusing to take the breast. On no account should such an infant be pacified by letting it sleep on the breast or by giving it a rubber nipple.

Vomiting.—A few infants thrive, in spite of considerable regurgitation. But if the vomiting is between feedings and habitual, the sign is important.

One should always keep in mind the possibility of pyloric stenosis when a breast-fed baby has obstinate vomiting.

Colic.—If only occasional, colic does not mean much, even though severe; but the baby that has continual discomfort, with more or less flatulence, is not getting the proper kind or quantity of milk, or it is being fed too frequently.

To prevent colic in the nursing infant the writer renders the intestinal flora less liable to decomposing changes by giving $\frac{1}{2}$ to 1 ounce (15 to 30 c.c.) of 3 to 4.5 per cent. of a **warm cereal gruel** immediately **before** each **nursing**, except the night nursing, and before each and every nursing if necessary. His results were excellent. Very few infants of whatever age have any perceptible difficulty in digesting a 3 per cent. starch mixture. Starch as a food is better borne and better tolerated by the infant than was formerly believed. Current (Northwest Med., Oct., 1920).

In most cases colic is due not only to too much fat but usually to too great a quantity of breast milk. One can reduce the quantity of breast milk, but it is well known that many

cases of colic do not respond to these simple methods. The following treatment proved successful: Morning and evening the child is given about 5 c.c. ($1\frac{1}{4}$ drams) of the liquid culture of active **lactic acid bacilli**, and each breast feeding is preceded with 1 Gm. (15 grains) of **powdered casein**. If it is impossible to obtain the powdered casein, one may carefully skim milk and take the **curd of the milk**. The quantity of curd to be used before each nursing is approximately that obtained from an ounce of skimmed milk. Ready co-operation of the mother is usually obtained when she learns that the treatment consists in giving the child some extra food. The treatment only brings results after a week or 10 days, but the benefit begins to appear in 24 to 48 hours. Grulee (Jour. Amer. Med. Assoc., Dec. 18, 1920).

In digestive intolerance of milk, with frequent vomiting, diarrhea, constipation, and a tendency to convulsions, whether in breast- or bottle-fed infants, **hypodermic injections of 5 to 10 c.c. (80 to 160 minims) of the milk** to which the child is intolerant are useful. Usually 1 injection suffices. The mother's milk may be administered raw or boiled; cow's milk should be boiled for 20 minutes. Weill (Jour. des prat., Sept. 20, 1920).

Daily addition of 2 or 3 Gm. (30 to 45 minims) of **lactic acid** (divided in 5 or 6 doses) was found to arrest dyspepsia, whether fermentative or putrefactive, in a very few days. Severe habitual vomiting and nutritional intoxication disappeared in a day if 10 to 20 Gm. ($2\frac{1}{2}$ to 5 drams) of **gelatin** were given in a liter (quart) of water in divided doses daily. Schaps (Jahrb. f. Kind., Apr., 1923).

Stools.—That the nursing is improper may be shown either by constipation, with dry, light-colored or greenish stools of foul odor, or by diarrhea, with thin yellow or green stools, four to ten a day, which contain curds and, after a time, mucus.

Sleep and Disposition.—Sleeplessness, restlessness, and fretfulness are generally due to hunger or indigestion.

During the latter part of lactation the signs of inadequate nursing, in addition to those already given, are: stationary weight or actual loss, delayed dentition, delayed closure of the fontanelle, flabby muscles with inability to sit or stand at the proper age, and anemia. There may be also symptoms of malnutrition or of incipient rickets.

The presence of all or of any one of these symptoms is enough to arouse suspicion, and the physician must determine whether the quantity or the quality of the breast-milk is at fault or both. This can be made out by the method already described, and then the proper treatment instituted as indicated below.

MEANS OF IMPROVING BREAST-MILK WHEN NURSINGS ARE NOT THRIVING.—

When the milk is poor an important consideration is whether this quality is due to a temporary or accidental cause—as severe labor or one of the complications of labor—or to a constitutional cause. In the former case much may be done; in the latter, almost nothing. If the milk is poor and scanty, the woman's general condition should be improved by giving a diet consisting largely of meat, eggs, milk, gruels, and liquids in abundance; a good extract of malt may be added. Out-of-door exercise, plenty of sleep, and freedom from anxiety are especially important. Gentle massage of the breasts often gives gratifying results, but it is imperative that the breasts and the hands of the operator be scrupulously cleansed before it is begun. (See AGALACTIA under MAMMARY GLAND, vol. VI.)

When the milk is excessively rich, and the quantity abundant, a reduction in the amount of meat, and the abstention from malted or alcoholic drinks, with active outdoor exercise, will usually reduce the ingredients to the standard. This condition of the milk frequently obtains with wet-nurses.

In conclusion, if the milk is very rich, the proportions can usually be reduced, by careful observation of the measures recommended, to a point where the infant is able to digest it. If the milk is poor and scanty there is less probability of success. In either case, *if, after two or three weeks' trial, the milk has not improved*, and the child continues to suffer from indigestion, it is better to wean at once, or secure another nurse, rather than persist longer in the attempt.

WET-NURSING.—To secure a good wet-nurse is difficult, and there is no certainty that her milk will agree with the foster-child. The ideal wet-nurse is a healthy, young, placid, unmarried primipara that lost her infant shortly after birth; she should be phlegmatic in temperament, and of sufficient intelligence to nurse the baby regularly. The actual wet-nurse in this country is usually a buxom married multipara whose baby and home-cares keep her constantly dissatisfied with her temporary occupation.

One may closely approximate the ideal by selecting a healthy woman between 20 and 30, not necessarily a primipara, who has a thriving infant. Women with syphilis, tuberculosis, chorea, or epilepsy should be excluded, both by their history and by examination of the hair, throat, skin, lymph-nodes, and chest. The Wassermann test should be made in every instance

and the woman rejected if it is found to be positive by a reliable laboratory. The breasts should be well-developed glands that become hard with milk within three hours after a nursing; the nipples should be of good size, well formed, and free from fissures.

The wet-nurse's child should, of course, be carefully examined. In regard to the age of the child, it need not correspond very closely to that of the foster-child. In general, the milk should not be more than six weeks old for a child of one to three weeks; if the foster-child is over six weeks, the milk may be from two to six months old.

It is more important that the woman be healthy, her baby thriving, and her milk free-flowing. In general it is safest to take a wet-nurse whose baby is at least three months old, the more surely to exclude hereditary syphilis.

An important caution is to see that the nurse is not overfed, and that she takes regular active out-of-door exercise; otherwise the milk is apt to become too rich.

To prevent the high death rate in infant hospitals due to the chronic malnutrition of the cases brought, Churchill has endorsed the employment of wet-nurses by such hospitals. Each nurse brings her own baby, and both are examined before engagement, the examination of the mother including the Wassermann test. The nurse is paid a certain amount per month, with board and room, and does general work about the ward. She nurses her own baby every 4 hours, usually on 1 breast. The other is pumped at the alternate 4 hours, the mammae being thus stimulated to activity every 2 hours. The milk is fed to the ward babies by bottle.

The difficulty of the wet-nurse problem is manifold. The plan of removing human milk and furnishing it apart from the mother offers a promising solution of the question.

In many cases a little breast milk, in addition to the bottle, has a most favorable effect. In New York, the Children's Welfare Federation started in 1921 to procure and distribute breast milk to aid in critical cases. Mothers willing to sell their milk come to the health stations, where the milk is expressed. Only mothers having more milk than is needed by their own babies are used. Their babies have to be under the care of a doctor and nurse in the health station, and the case has to be recommended by them. All the milk is pooled and put in large bottles on ice. One mother gave 40 ounces a day and supplied milk for 11 months. Lactation may be prolonged for 15 to 18 months, and the composition of the milk later differs very little from that of the earlier milk. Those buying the milk are required to pasteurize it before use, no Wassermann test having been made on the mothers. Human milk can be as advantageously fed from a bottle as directly from the breast. Milk from any period of lactation can usually fit a baby of any age. Especially during the first month or two can infant mortality be thus reduced. Chapin (*Arch. of Ped.*, July, 1923).

Study of the influence of diet on lactation in over 400 cases. An excess of food did not increase milk production. A high protein and balanced diet seems to meet the needs of the mother and infant, without excessive calory intake, better than either a high fat or high carbohydrate diet. Liberal protein feeding proved to be of definite value in securing maximum milk production. E. L. Adair (*Amer. Jour. of Obst. and Gyn.*, Jan., 1925).

WEANING AND MIXED FEEDING.—With few women among the better classes can nursing be continued beyond the ninth, and generally not beyond the sixth or seventh month, without exhausting the mother or partially starving the child.

When Should Weaning be Begun?

—Stationary weight or actual loss, the child being otherwise well, means insufficient food. After the sixth or seventh month this indicates weaning. Anemia, as shown by pallor of the lips, or by blood examination, is another such indication. Before the sixth month the attempt may be made to improve the milk by the means already suggested, using in the meantime supplemental bottle feedings two or three times a day. If the milk does not become normal in amount, it may still satisfy the infant at three or four nursings daily, the bottle being given in place of the other nursings.

This method of "mixed feeding" may be very profitably continued as long as the child thrives: It is much better for the child than complete weaning. If the nurse cannot satisfy the baby at least twice a day, the child would best be weaned. Speaking generally, weaning should be begun at the ninth or tenth month; but even then the weekly weighing is the safest guide.

Method of Weaning.—At whatever time begun, the process should be gradual, if possible, lest the mother have trouble with her breasts, and the child with its stomach and bowels. At first a bottle should be given twice a day: If the food causes no indigestion the number of feedings and the quantity may be gradually increased up to the full quota for the child's age, according to the data given below, under "Modification of Milk for Healthy Infants During the First Year," page 125.

If the baby is under 4 months old, the food for the first few days should be as weak as that for a newborn

child; if from 4 to 9 months, the formula should be at first that for a month-old child; and, if from 9 to 12 months, that for a 3-month child. The important point is always to start with a sufficient quantity of very dilute food, and afterward increase the proportions as rapidly as the child can assimilate them.

As Pinard advised, weaning should be gradual. During weaning the mother should expose herself to fatigue as little as possible; the breasts should be enclosed in a binder and may be gently rubbed, morning and evening, with warm sweet-almond oil. The use of purgatives is not indispensable; but she should reduce the quantity of fluids taken.

A fair average in weaning is to start at $\frac{1}{2}$ the strength of what would ordinarily be given to a healthy infant of the same age. If the child can digest this, the formula can be increased cautiously. It is wiser, as a rule, not to wean the baby during the hot summer months, thus avoiding gastrointestinal disturbances, unless one goes to a cool climate. Graham (Penn. Med. Jour., Aug. 1919).

ARTIFICIAL, OR SUBSTITUTE, FEEDING.—In order that an infant may properly thrive on an artificial food, certain fundamental principles must be complied with, *viz.*:—

The food must contain the same nutritive ingredients as breast-milk, and in about the same proportions.

As a food which, in quantity and correlation of fat, protein and carbohydrate, more nearly simulates breast milk than any other mixture, the author commends the **butter-flour mixture** of Czerny and Kleinschmidt. In its preparation, 70 Gm. of butter are heated in a pan over a gentle flame until foaming takes place and the odor of fatty acids has disappeared (3 to 5 minutes); 70 Gm. of flour are added and the mixture again heated,

with constant stirring, until thin and brownish (4 to 5 minutes); 1 liter of water is then slowly added, and finally 50 Gm. of cane sugar. The mixture is boiled and rubbed through a fine sieve. The required amount of it can be added to the desired amount of milk, previously boiled and cooled, and the whole kept cool until needed. The butter-flour mixture permits giving fat without the disturbances otherwise frequently observed. It may be used: (1) As artificial nourishment for the healthy infant, a total of fluid not in excess of that taken by a breast-fed child being given; (2) in children with eczema, recurrent nasopharyngitis or rhinitis, chronic bronchitis, etc.; (3) in premature infants who must have an artificial diet; (4) in atrophic infants; (5) in spasmodophilia; (6) in the period of reparation following acute diarrheal disturbances. It should never be used in acute diarrhea with fever and loss of weight. H. M. Greenwald (Arch. of Ped., Dec., 1923).

Buttermilk recommended as bottle food for weak infants during the first month of life, or where there is insufficient breast feeding. Buttermilk prevents digestive disturbances and wards off malnutrition. Marfan, Turquetty and Aris (Paris méd., Nov. 1, 1924).

As nearly as possible the elements of the food should resemble those of breast-milk, both in chemical composition and in their behavior to the digestive fluids.

In accordance with these principles, cows' milk is selected, because it furnishes the elements required, although not in proportions best suited to the infant's needs.

Dried milk is superior to condensed milk, and is often preferable to an unsafe fresh milk in the summer time or in traveling. It should not have been kept longer than 2 or 3 months. Addition of other food to provide enough vitamins is necessary. The

dried milk should not be continued longer than 1 to 3 months. Schoedel (Jahrb. f. Kind., Sept., 1925).

COWS' MILK.—Differences between Cows' Milk and Breast-milk.—

The composition of good breast-milk and cows' milk is given in the table:—

Constituents.	Woman's Milk, Average.	Cows' Milk, Average.
Fat	4.00 per cent.	4.00 per cent.
Sugar .	7.00 per cent.	4.50 per cent.
Proteins	1.25 per cent.	3.50 per cent.
Salts ..	0.20 per cent.	0.70 per cent.
Water .	87.55 per cent.	87.75 per cent.

It appears, therefore, that cows' milk contains a large excess of proteins and of salts, but too little sugar; the fat is present in about the same proportion in both. Moreover, cows' milk contains numerous bacteria.

Cows' milk is made more digestible by addition of acid, and can then be given in considerably larger amounts. To prepare *acid milk*, a good grade of cows' milk is first sterilized by boiling for 5 minutes, then cooled and the scum removed. **Lactic acid**, U. S. P., 1 dram (4 c.c.) to each pint of milk, is then dropped in slowly while the milk is gently stirred. A smooth, homogeneous preparation should result, which keeps well even if not placed in a refrigerator. In the feeding, dilution is not usually necessary. Carbohydrate—preferably Karo corn syrup—should be stirred into the lactic acid milk, since the sugar present is insufficient for the average infant. The entire day's feedings are made up at one time and kept cool until used. A mixture of corn syrup, 1 ounce, with lactic acid milk, 1 pint, may be used satisfactorily throughout the first year. The infant is given about as much as he desires every 4 hours. Good results were obtained in sick infants. W. McK. Marriott and L. T. Davidson (Jour. Amer. Med. Assoc., Dec. 15, 1923).

Fat.—The average amount of the fat of cows' milk which a healthy in-

fant can digest varies from 2.0 to 4.5 per cent. Beginning with 1.5 per cent., or lower, in the early days of life, the amount may be increased to 3.0 per cent. at one month, and 4.0 per cent. at five or six months.

Sugar.—The sugar in both kinds of milk is simply lactose in solution; but the proportion in cows' milk is only about two-thirds that in breast-milk.

Proteins.—The proteins show the greatest differences, both in quantity and in character. A good average breast-milk contains nearly 1.5 per cent. of proteins, of which about one-third is casein and the other two-thirds the soluble and easily digestible lactalbumin. Cows' milk contains nearly 4 per cent. of proteins, of which four-fifths is casein, while only about one-fifth is lactalbumin. Stated in another way, breast-milk contains about 1 per cent. of lactalbumin and 0.5 per cent. of casein, while cows' milk contains only about 0.8 per cent. of lactalbumin, but 3.2 per cent. of casein.

Inorganic Salts.—The salts are about three and a half times more abundant in cows' milk.

Reaction.—The reaction of cows' milk is acid, while that of human milk is more nearly alkaline, rarely neutral.

Bacteria.—Breast-milk is practically sterile, while cows' milk always contains germs, some of which may be pathogenic. A large proportion of diarrheal diseases are believed to depend upon the saprophytic bacteria; and typhoid, cholera, diphtheria, tuberculosis, and scarlatina may be transmitted by cows' milk.

After wasting illnesses infants may not gain for long periods if fed only breast milk, but will gain at once if

cows' milk protein is added to the breast milk feedings or mixed feeding is begun. The same phenomenon is sometimes observed in premature infants who fail to gain on breast milk alone but gain on combinations of breast milk and cows' milk. Apparently the protein and salts in breast milk are not adequate to meet the abnormal requirements of convalescence. E. A. Park (N. Y. State Jour. of Med., Nov., 1924).

The antirachitic property of cows' or human milk exposed to the ultra-violet rays was confirmed by the writer. Overfeeding with milk prevents recovery, however, from the associated anemia. Hottinger (Schweiz. med. Woch., Feb. 27, 1926).

STERILIZATION AND PASTEURIZATION OF MILK.—The purposes of "sterilizing" milk are: 1. The destruction of pathogenic bacteria which may have gained entrance. These are, in particular, the germs of typhoid, diphtheria, cholera, tuberculosis, the streptococci of septic sore throat, and those which produce diarrheal diseases. The milk may receive this contamination from disease in the cow, from the milker's hands, or from the water in which the pails, cans, and jars are washed. The close connection which exists between the diarrheal diseases of summer and a contaminated milk-supply must never be lost sight of. The fact that these pathogenic germs are so frequently present, together with the fact that milk in cities is twenty-four to forty-eight hours old, and must often be kept without ice, makes some means of destroying the germs desirable or imperative.

2. The destruction of the ordinary germs of lactic-acid fermentation is desirable in order that the milk may be kept safely for a longer time.

Boiling Milk.—For practical purposes, boiling the milk for three minutes is all that is necessary. Among the advantages of this procedure are that it is bactericidal and is attended, probably, with less vitamin destruction than occurs where a lower heat is applied over a longer period, as in pasteurization. The milk is certainly more easily digested, as it inhibits the formation of large curds. Constipation does not necessarily occur, or if it does, it is a good fault. The "laxative" properties of raw milk may be said to be due to indigestion. It is not known that boiling milk can cause scurvy or rickets or any other disease. In modern feeding, where orange juice and cod-liver oil are added to the diet at an early age, all objectionable features of boiling milk are eliminated.

Pasteurization of Milk.—By this is meant the heating of milk for one-half hour or more at a temperature of 155° to 170° F. The only advantage claimed for its employment appears to be that it does not change the taste. This is negligible, as infants do not object to either boiled or pasteurized milk. The latter is bacteriologically and physiologically inferior to boiled milk. As to coagulation time, it is like raw milk (Brenneman). Pasteurization is a complicated process and there is no argument in favor of it. Commercially pasteurized milk is kept from one to two days, is "stale," and, in this respect, may be a cause of scurvy (Hess).

MODIFICATION OF MILK FOR HEALTHY INFANTS DURING THE FIRST YEAR.—Not all infants, even if normal and healthy, can be fed in the same way. The pro-

blem, therefore, is to make a food in which the quantity of each ingredient—fat, sugar, and protein—shall be known, and in which, also, these quantities can be separately varied so as to suit the digestive capacity and peculiarities of the individual child.

Milk Laboratories.—In several cities of the United States, and in London, there have been established milk laboratories that put up modified milk in accordance with the prescription of the attending physician. Any combination may be ordered, and the food will be pasteurized or peptonized if desired.

Moreover, artificial buttermilk, fermented by the Bulgarian bacillus, and also Finkelstein's Eiweissmilch (albumin milk) may be obtained from some of these Walker-Gordon Laboratories. For the great mass of our population, however, these laboratories are not available, so that the milk must be modified at home.

Protein milk is essentially a calcium caseinate, produced by precipitating the casein from milk with rennet or other protein coagulant, and rendered soluble by neutralization with calcium hydroxide and subsequent evaporation to dryness. It is more easily prepared for use than Finkelstein's Eiweissmilch, requiring only milk and water, or water alone. It keeps well for 6 months or longer on ice. There are several brands on the market. The composition of protein milk is, approximately: Protein, 3 per cent.; fat, 2.5; carbohydrates, 1.5; salts, 0.5. It is not a permanent food, and is not to be continued longer than necessary, usually no more than 5 or 6 weeks. Its caloric value is only about 12 to the ounce. It should not be given more than 1 or 2 days without addition of some sugar. It is indicated in all fermentative diarrheas with green, sour, acid, and loose stools, where due to carbohy-

drates. It is also beneficial in infectious diarrheas, where the dyspepsia is secondary to some infection outside the alimentary canal. Dyspepsia due to fats and diarrheas of mixed types are also favorably affected.

A. I. Blau (Med. Jour. and Rec., Apr. 2, 1924).

Home Modification of Milk.—This need not be a complicated procedure, but a few underlying principles should be understood and applied. All agree that milk should be modified in some way to meet the requirements of the young infant. With this in view, many ways and methods have been tried, which are often simply different means of arriving at the same end.

Whole milk, which has been advocated to some extent by the French and English for infants over five or six months, has found little favor in this country.

Biedert and Meigs advocated mixtures in which the protein, formerly thought to be the most indigestible element, was reduced. Rotch had similar views, suggesting only slight changes. All emphasized the percentage of each food element as the basis or starting-point of milk mixtures. To accomplish this purpose, various amounts of "top milk," or known percentages of cream, were used, resulting in complicated formulæ, which were discouraging to those who conscientiously wished to learn infant feeding. Undoubtedly these complicated methods have increased the sale of patent and proprietary foods.

The simplest means employed in feeding infants successfully is the most desirable. The use of **simple milk dilutions** is generally advocated throughout the country, except in

certain limited areas. These dilutions furnish the proper proportions of all of the elements essential for the growing organism, and a simple calculation will supply the information concerning the required percentage of each.

MILK VOLUME.—One and one-half ounces of milk per pound of body weight will supply sufficient protein (1.5 Gm.) and fat (1.6 Gm.). The total amount of milk, however, should never exceed 32 ounces. One-tenth of an ounce by weight of sugar per pound of body weight will furnish the proper amount of sugar, *i.e.*, from 1 to 1½ ounces. (See further on, Table of Domestic Equivalents). Anything beyond this should be supplied by cereal.

The salts are ample in any dilution.

CALORIES.—During the first six months of life, for an infant of average weight, 100 calories per kilogram, or 46 calories per pound of body weight, are recommended. During the latter half of the first year, 88 calories per kilogram, or 40 calories per pound, will meet the requirements.

In feeding an underweight infant, one should aim to give a mixture containing the number of calories which an infant of average weight for that age would have. A start should be made with a weaker mixture and this worked up gradually to the proper strength. The following simple rules will be found to work out practically:—

DILUTION.—Half and half for the first two months. Gradually increase to a two-thirds mixture and retain this to eight months. The strength is rarely increased to four-fifths until nearly the end of the first year, because much water is needed to satisfy

the fluid requirement (3 ounces per pound of body weight for the first six months; $2\frac{1}{2}$ ounces per pound for the latter half of the first year). Whole milk is not necessary until the age of twelve months.

AMOUNT AT EACH FEEDING.—Begin with 3 ounces; this may be raised to 4 ounces by the end of the first month, $4\frac{1}{2}$ ounces during the second month, 5 to $5\frac{1}{2}$ ounces during the third month, etc. Approximately, the infant will take, after three months, from 1 to 2 ounces more at a feeding than it is months old—up to 8 or 9 ounces.

INTERVALS.—The intervals between feedings should preferably be four hours. Most infants will thrive on these intervals. Colic is thus eliminated. Some, however, will require a feeding every three hours. (The schedule for bottle-fed infants is the same as that for nursing infants).

NUMBER OF FEEDINGS.—On the four-hour schedule, for the first five weeks there should be six feedings; from five weeks to ten months, five feedings; from ten to twelve months, four feedings. On a three-hour schedule, at the same age periods, there should be seven, six, and five feedings, respectively.

Example.—The preceding practical rules will be applied in a simple illustration:—

Infant aged 5 months.

Weight: $15\frac{1}{2}$ pounds.

Total milk mixture=35 ounces.

(5×7 , that is, the number of feedings in the 4-hour schedule \times 2 ounces more than the infant is months old).

[*Note.*—It must be understood that all methods of arriving at the amount of the total mixture are only approximate. One may multiply pounds of normal weight for age by 3 for the first 2 months; aft-

that, by $2\frac{1}{4}$. Subtracting from this the ounces of milk to be given for an infant of normal weight for that age indicates the amount of the diluent.]

Amount of milk= $23\frac{1}{2}$ ounces.

($1\frac{1}{2}$ ounces \times $15\frac{1}{2}$ pounds).

Amount of water= $11\frac{1}{2}$ ounces.

($35 - 23\frac{1}{2}$).

Caloric requirement=697.

(weight $15\frac{1}{2}$ pounds \times 45 calories).

$23\frac{1}{2}$ ounces of milk=493 calories.

Calories to be made up=204.

$1\frac{1}{2}$ ounces of sugar=180 calories.

This leaves a negligible deficiency of 24 calories, which is more than made up by the addition of orange juice and cereal to the diet.

The formula, then, is:—

Milk, $23\frac{1}{2}$ ounces.

Water, $11\frac{1}{2}$ ounces.

Sugar, $1\frac{1}{2}$ ounces (see Table of Domestic Equivalents, below).

Total, 35 ounces.

If the infant is on the 4-hour schedule, this total is divided into five bottles of 7 ounces each; if on the 3-hour schedule, into six bottles of 6 ounces each.

If this same child of 5 months weighed only 10 pounds, its caloric requirement would be the same as for $15\frac{1}{2}$ pounds, *i.e.*, the average weight for an infant of that age. The calories per pound of such an infant would be $697 \div 10 =$ approximately 70 (*energy quotient*). One should commence with a smaller amount of food and gradually increase to the full amount.

Table of Domestic Equivalents.—

The standard tablespoon: Two level tablespoons of water, or any substance, should equal one ounce by measure in a graduate. For convenience, one may measure with a tablespoon whenever possible.

The standard teaspoon: Three level teaspoons should equal one tablespoon.

Difference in Weight of Sugars.—

A lighter sugar requires to be given in larger volume to accomplish the same result as that obtained with a heavier sugar. Thus:—

Two level tablespoonfuls of cane sugar, or corn syrup, equals one ounce by weight.

Three level tablespoonfuls of milk sugar equals one ounce by weight.

Four level tablespoonfuls of dextri-maltose equals one ounce by weight.

Varieties of Sugars and their Values.—Cane sugar, granulated, may agree with the infant as well as any other. The same is true of milk sugar, but it is no better than cane sugar. Maltose, dextrin and corn syrup are the most easily digested, and are used by preference.

Use of Alkalies in the Milk Mixture.—The purpose is to make the curd smaller and softer, *i.e.*, to prevent the agglutination of smaller curds into larger masses. Cereal water, lime water, milk of magnesia, and sodium citrate are all used to effect this result. Their use is not necessary if the milk is boiled.

Boiling Milk.—This should be done throughout the infant's first year. The milk is to be boiled for 3 minutes. This accomplishes all and more than pasteurizing and is much more simple.

Vitamines.—These are the fat-soluble A, the water-soluble B, and the antiscorbutic C. Fat-soluble A is present principally in milk, butter, egg yolk, fat, spinach, Brussels sprouts, kale, cabbage, lettuce, white potatoes, sweet potatoes, carrots, beets, parsnips, and turnips. Water-soluble B is present largely in yeast, and also in eggs, lemons, apples and grapes, potatoes, carrots, and turnips. Liver and sweetbreads are moderately

rich in it. Water-soluble C is present in cabbage, turnips, lettuce, water cress, potatoes, lemons, oranges, raspberries, and tomatoes.

Codliver Oil.—This should be started at three or four months in amounts of 5 to 20 drops three times daily, and continued until the age of eighteen months.

Other Foods in the First Year.—Other foods should be given at five months. The infant is well able to take care of them at this time.

Orange Juice.—This should be begun at the end of the second month and increased gradually to 10 teaspoonfuls daily.

Five to Twelve-Month Diet List.

6 A.M.	Bottle or nursing.	Approx. No. of Cals.
Between 6 A.M. and 10 A.M.,	1	
teaspoonful to 2 tablespoonfuls of orange juice (strained), diluted at first	12	
10 A.M.	Some cereal jelly, preferably oatmeal (but whichever is palatable), ½ level tablespoonful, increasing gradually to 3 level tablespoonfuls. (Later, any well-cooked cereal)	18-36

Bottle or nursing, after the solid food.

2 P.M. Beef juice, 1 teaspoonful, increased to 1½ tablespoonfuls; to be diluted one-half at first 5

Vegetables.—Start with ½ teaspoonful and put through strainer; gradually increase any one vegetable up to 1 level tablespoonful.

By the beginning of the eleventh month, the child may have 1 level tablespoonful each of 2 vegetables. 12-24

Such vegetables should be used as can be cooked in ½ hour or less, beginning with potato—cooked with the skin on,—carrot, or spinach.

Approx. No.
of Cals.

Toward the latter part of the first year: Peas, string beans, cauliflower, asparagus tips.

Bottle or nursing, after the solid food.

The child should have a chicken bone or bone of lamb chop, with almost all the meat taken off, every day or so, to gnaw on.

6 P.M. Bottle or nursing, after the solid food.

At the beginning of the tenth month, 3 level tablespoonfuls of cereal.

10 P.M. Bottle or nursing. (To be discontinued at the beginning of the eleventh month.)

Divide one piece of toast, 3 by 3½ by ½ inch, into 3 or 4 portions and give during the day, at or around mealtime. This is to be started at once 62

Approximate value of the additional foods (bottle mixture not included) 109-139

COMMENTS ON THE DIET LIST.—

Cereals.—Usually a cereal jelly should be used in the beginning, and later—at eleven to twelve months—well-cooked cereal, a teaspoonful at first, gradually increased to 3 tablespoonfuls.

Vegetables.—

Variety.—The root vegetables, as carrots, parsnips, potatoes, and others, such as spinach, Brussels sprouts, kale, peas, and asparagus tips.

Amount.—A teaspoonful of these, cooked for ½ hour and strained. This is to be increased gradually to 2 or 3 tablespoonfuls later.

White Bread.—This has a high fuel value, but few vitamine substances. The latter are supplied in other foods.

Bread is also important, if given in crusty form (French or Vienna), or as crisp toast or zwieback, as a “toothbrush,” to develop the jaws. Its starch value is high.

Butter.—This should be put on bread or toast, as it is rich in vitamins.

Chicken and Beef Bones.—The infant is given these to gnaw on, whether teeth are present or not, to develop the jaws and aid in the eruption of the teeth.

Beef Juice.—It is necessary for the organism and takes up little space. The amount should begin with 1 teaspoonful, to be gradually increased to 1½ tablespoonfuls.

Soup or Broth.—These have very little value as nourishment, except for the vegetables in them. They take up space in the stomach which could be used to better advantage. They are given as a change and a palatable relish.

The solid food should always be first, before the bottle or nursing. Only one new thing should be started at a time.

As an aid in changing from milk feedings to a varied diet, the writer advocates a *calves' marrow soup*, prepared by cooking 5 Gm. (75 grains) of wheat grits in 100 c.c. (3½ ounces) of water with a little salt and adding 5 Gm. of calves' marrow. The preparation is sweetened with saccharin. Its protein content is 0.62 per cent. and its nutritive value, 45 calories per 100 Gm. F. Wiltchke (Arch. f. Kind., Dec. 18, 1923).

INDICATIONS FOR SPECIAL MODIFICATIONS.—I. Flatulence

and Habitual Colic.—These symptoms are almost invariably due to overfeeding, the food being too strong or given in too large quantity,

or too rapidly, or most often because the baby is fed at too frequent intervals.

II. Curds in the Stools.—If soft and small, these have no practical significance; if they are soft, large, and yellow, they are probably due to undigested fat, and a milk less rich in cream, or skimmed milk should be used. If they are hard, glistening, and yellowish or white, elastic, and showing a granular surface when broken up, they are due to undigested casein. The difficulty may be remedied either by **boiling the milk** or by **lessening the quantity of milk in the formula**.

III. Vomiting.—If shortly after feeding, the regurgitation is generally to be remedied by diminishing the quantity or the frequency of the feedings, or both. If the vomiting occurs an hour or so after a feeding it is often due to too much fat.

In conditions of slow stomach digestion it is far better to **feed every four hours**, rather than every three hours.

In 15 cases **thick feeding** at once arrested a tendency to vomiting. The procedure consisted in giving 1 or 2 teaspoonfuls of thick gruel or potato purée a few minutes before each nursing. The weight of the gruel seems to check an acquired abnormal tendency of the peristolic reflex. Success of this measure helps to exclude an anaphylactic or syphilitic origin of the vomiting. In 2 instances a little **atropine** was required in addition to curb the vomiting. Cozzolino (Clin. ped., Aug., 1925).

In any X-ray study of the infant's stomach, the majority of infants who vomited were found to have big stomachs with a large air bubble. Thickening of the food and discarding of the bottle or breast feeding reduced the size of the stomach and, with it,

the vomiting. Thick food is shown by the X-ray to induce a peristole, and the stomach appears small, whereas fluids inhibit the peristole and promote the swallowing of air. Air swallowing is more marked in breast or bottle feeding than in feeding with a spoon. Hotz (Schweiz. med. Woch., Dec. 3, 1925).

Deficiency of water intake in breast-fed infants may cause vomiting as a cerebral symptom. Dehydration fever occurs oftenest on the 3d day of life. The infant's mouth becomes dry, with the tongue red, granular, and resembling corned beef. The fontanels are depressed and the abdomen scaphoid. The skin is dry and retains folds in it. The voice is hoarse. Licking movements are observed, and any water presented is eagerly taken. It should be remembered that an infant requires 150 c.c. of water a day per kilo. of weight. In dehydrated infants rectal use of fluid may be called for. Hirsch (Zeit. f. Kinderh., Feb. 20, 1926).

IV. Loss of Appetite.—The indication is to **make the intervals of feeding longer**, the **quantity smaller**, and the **food more dilute**; this applies particularly to the fat. The symptom indicates feeble digestion, for the time being, and can best be treated by greatly reducing the amount of work required.

V. Constipation.—This is a frequent symptom, and is always hard to control. The difficulty often is that there is insufficient residue, and this is to be overcome by **increasing the proportions of all the ingredients**. A second cause is too small a percentage of fat; but it is seldom advisable to increase the fat above 4 per cent. because of constipation.

Too often the constipation depends on bad habits rather than on anything wrong with the food; so that **early training** is of very great importance.

The addition of a **larger amount of milk-sugar**, if it does not cause vomiting, may overcome the constipation.

The writer introduces **honey** in all his formulas for substitute feeding, and also uses it in marasmus, rickets, scurvy, malnutrition and other conditions, in place of various sugars, cod-liver oil or patent foods. It is more rapidly absorbed than lactose, does not undergo butyric fermentation like maltose (avoiding acidosis), and infants fed on it rarely show flatulence. It also contains some protein. Its laxative action is lost on boiling. Luttin-gér (N. Y. Med. Jour., Aug. 2, 1922).

VI. Diarrhea.—A diarrhea which has as a cause simply a wrong proportion in the food is very rare. Frequent, almost normal movements, however, may be due to too high fat. Generally the diarrhea is due to acute or subacute indigestion in the intestines. **Withholding all milk food for twenty-four hours and the use of plain water** is advisable. Then, either **protein milk** or a **boiled skimmed-milk mixture** may be used, the strength of the formula being low at first, and gradually increased each day as the digestive symptoms improve.

Of 20 hard-feeding cases placed on lactic acid milk with corn syrup, a large majority did very well. **Fat-free lactic acid milk** has proved valuable in fermentative diarrhea and carbohydrate indigestion, and **albumin milk** in acute sugar or fat indigestion and in some mixed cases such as indigestion with fermentation, fermentative diarrhea and infectious diarrhea. Many infants who did not thrive on ordinary milk mixtures did well on dry milk (partially skimmed). Among other conditions benefited were certain cases of vomiting; also of diarrhea when albumin or lactic acid milk was not obtainable, or where the cow's milk was under suspicion, especially in hot weather. **Cereal gruels** proved ex-

cellent in persistent vomiting or failure to gain on ordinary milk mixtures. Generally farina was used, 1 level tablespoonful to 5 ounces of milk or water, which was then boiled, water being added to replace that evaporated. Giffen (Ohio State Med. Jour., Dec., 1922).

Unsuspected insufficiency of nourishment is a frequent cause of indigestion in breast-fed infants. This occurs where the mother is not secreting enough milk. Such starvation may thus be the actual cause of restlessness, vomiting, and diarrhea, with or without loss of weight, weakness, and periods of constipation. Toverud (Norsk. Mag. f. Laegevid., Nov., 1925).

VII. Failure to Gain in Weight.—

This symptom, in a child with a good appetite and good digestion, means insufficient nourishment. The quantity of the food should first be **increased**, and then the strength of the milk mixture gradually raised, so as not to disturb the digestion. Frequently the addition of some **cereal** or of **beef-juice** and **egg** to the dietary, with **reduction of the milk**, will prove efficacious.

Stress laid on the *suction difficulties* of young infants. Incoördinate and halting suction impedes lactation and results in aërophagy. Rather than use mixed feeding as an aid in reestablishing breast feeding, the infant should be put to the breast at regular intervals, and after it has done its best the **breast-pump** used vigorously and the milk obtained given with a spoon. The mother's body should be inclined forward, so that the breast is pendulous and the nipple falls directly toward the child's mouth. Nervous excitement of the child is much the commonest cause of failure of lactation in the early weeks. As a result the child's sucking power rapidly decreases. Such infants must be **made** to sleep, and should be put to the breast when drowsy and quiet. **Hot**

baths or hot packs are also of value; or, the child may be wrapped tightly in a shawl. H. C. Cameron (Lancet, May 13, 1922).

Infants below 5 months of age who did not thrive on breast feeding started to gain when given small quantities, viz., 0.2 Gm. (3 grains), of albumin mixed with the milk obtained by the breast pump. The gain occurred even if the total calories taken were diminished. Langer and Schmal (Zeit. f. Kind., Jan. 19, 1925).

L. EMMETT HOLT,
New York,
AND
ALBERT J. BELL,
Cincinnati.

NUTMEG (*Myristica*, U. S. P.) is the kernel of the ripe seed of *Myristica fragrans*, family Myristicaceæ. It is obtained from a small, evergreen, dioecious tree, a native of the Molucca Islands, but is now obtained wholly from trees cultivated in various tropical countries, which bear a fleshy fruit resembling a peach. At maturity the pericarp splits into halves, disclosing the solitary seed covered in part by the scarlet aril which, removed and dried, constitutes macis or mace. Nutmeg contains 2 to 8 per cent. of a volatile oil (oleum myristicæ), 25 per cent. of fixed oil, proteins, gum and starch.

PREPARATIONS AND DOSES.—The preparations are:—

Myristica, U. S. P. (nutmeg). Dose, 5 to 10 grains (0.30 to 0.60 Gm.).

Oleum myristica, U. S. P. (volatile oil of nutmeg). Dose, ½ minim (0.03 c.c.).

Pulvis aromaticus, N. F. (aromatic powder), contains 15 per cent. each of nutmeg and cardamom seed, and 35 per cent. each of ginger and cinnamon. Dose, 15 grains (1 Gm.).

The B. P. recognizes a 10 per cent. spirit of myristica; dose, 5 to 20 minims (0.3 to 1.2 c.c.).

Myristica kino is obtained from the nutmeg grown in India. It resembles very closely the Malabar product and contains about 30 per cent. of kinotannic acid. Dose, 10 to 20 grains (0.60 to 1.3 Gm.).

PHYSIOLOGICAL ACTION.—Nutmeg possesses aromatic and carminative properties and considerable narcotic power; in overdose it causes stupor and delirium. The narcotic effect is due to "myristicin," the high-boiling part of the volatile oil.

POISONING BY NUTMEG.—Gillespie and others have reported cases where large doses of this drug have produced frontal headache, vertigo, free diaphoresis and urination, narcosis, and collapse. In Gillespie's case 5 powdered nutmegs had been taken to procure an abortion. Marked poisoning has been observed from 1 to 1½ nutmegs, and from a teaspoonful of mace.

Treatment of Poisoning.—An emetic of zinc sulphate, 30 grains (2 Gm.), followed by small repeated doses of aromatic spirit of ammonia, is indicated.

THERAPEUTIC USES.—The volatile oil may be used as a rubefacient in rheumatism, neuralgia, and paralysis. Internally the powdered or grated drug has been used as a carminative, anodyne, and astringent, to relieve nausea, and for diarrhea, colalgia, and intestinal spasms. Small doses favor digestion by stimulating the secretion of gastric juice. In delirium tremens, the narcotic properties of nutmeg may be utilized. W.

NUX VOMICA AND STRYCHNINE.—Nux vomica (poison nut, vomit nut, Quaker buttons, semen strychni) consists of the dried, ripe seeds of *Strychnos nux-vomica*, a tree of the natural order Loganiaceæ, growing in the East Indies, Ceylon, Cochin China, and northern Australia. All parts of the tree are bitter and poisonous. The seeds are disk-shaped, about an inch in diameter and one-sixth inch thick, covered with silky hairs, of a grayish-yellow or grayish-green color, and grayish-white internally. They are very tough and are reduced to powder with difficulty. While devoid of odor, they are very bitter to the taste. These seeds contain the alkaloids *strychnine* and *brucine* in the total amount of from 1.5 to

5 per cent., the former alkaloid constituting from one-third to one-half of the whole. In combination with these alkaloids is found a body related to tannic acid, *viz.*, *igasuric acid*. There are also present the glucoside *loganin*, a yellow coloring matter, a concrete oil, gum, starch, wax, and earthy phosphates. The powdered drug varying in alkaloidal strength, it is necessary to have the preparations of nux vomica standardized to insure uniformity of physiological effect.

[*Ignatia* may be briefly considered here on account of its close resemblance to nux vomica, not only as to alkaloidal constituents, but also on account of the similarity of its physiological action and therapeutic uses. *Ignatia* (bean of St. Ignatius) is the seed of the *Strychnos ignatii*, a woody climber indigenous to the Philippine Islands, where the seeds have been used as medicine by the natives. The Jesuit missionaries named it in honor of the founder of their order. The seeds of *ignatia* are irregular in shape, slightly ovoid or oblong, grayish-black, and more or less translucent, and contain about the same percentage of the two alkaloids as nux vomica. Tincture of *ignatia* (unofficial) may be given in doses of 1 to 15 minims in all diseases in which nux vomica is indicated.]

PREPARATIONS AND DOSE.

—The official preparations of nux vomica are as follows:—

Nux vomica, U. S. P. (nux vomica), the entire or powdered seed, required officially to contain not less than 2.5 per cent. of the alkaloids of nux vomica. Dose, $1\frac{1}{2}$ grains (0.1 Gm.).

Extractum nucis vomicæ, U. S. P. (extract of nux vomica), made by maceration of nux vomica in a mixture of 75 volumes of alcohol, 1 of acetic acid and 24 of water, percolation, and removal of fats with benzine by an officially prescribed process. The dry extract finally obtained

is required to contain from 15.2 to 16.8 per cent. of the alkaloids of nux vomica. Dose, $\frac{1}{6}$ to $\frac{1}{2}$ grain (0.01 to 0.03 Gm.).

Tinctura nucis vomicæ, U. S. P. (tincture of nux vomica), made by maceration in a mixture of 75 volumes of alcohol, 1 of acetic acid and 24 of water, followed by percolation, which is completed with a 3:1 mixture of alcohol and water. It is required to contain, per 100 c.c., 0.237 to 0.263 Gm. of alkaloids. Dose, 5 to 25 minims (0.3 to 1.6 c.c.).

Following are the official salts of the alkaloid strychnine:—

Strychninæ nitras, U. S. P. (strychnine nitrate) [$C_{21}H_{22}N_2O_2 \cdot 11NO_3$], occurring in colorless needles with an intensely bitter taste. One Gm. is soluble in 45 c.c. of cold water, 10 c.c. of boiling water, 150 c.c. of alcohol, and 105 c.c. of chloroform; it is insoluble in ether. Dose, $\frac{1}{80}$ to $\frac{1}{12}$ grain (0.00075 to 0.005 Gm.); official dose, $\frac{1}{30}$ grain (0.002 Gm.).

Strychninæ sulphas, U. S. P. (strychnine sulphate) [$(C_{21}H_{22}N_2O_2)_2 \cdot H_2SO_4 \cdot 5H_2O$], occurring in colorless prismatic crystals or as a white crystalline powder, with an intensely bitter taste. Strychnine sulphate effloresces in dry air. One Gm. is soluble in 35 c.c. of cold water, 7 c.c. of boiling water, 81 c.c. of alcohol, and 220 c.c. of chloroform; it is insoluble in ether. Dose, $\frac{1}{80}$ to $\frac{1}{12}$ grain (0.00075 to 0.005 Gm.); official dose, $\frac{1}{30}$ grain (0.002 Gm.).

Following are two preparations which were formerly official:—

Ferri et strychninæ citras, U. S. P. VIII (iron and strychnine citrate), containing 16 per cent. of iron and about 1 per cent. of strychnine, and occurring in garnet-red to yellowish-brown scales,

with a bitter, mildly ferruginous taste, deliquescent when exposed to moist air, soluble in water and partly soluble in alcohol. Dose, 2 grains (0.125 Gm.).

Glyceritum ferri, quininae et strychninae phosphatum, U. S. P. VIII (glycerite of the phosphates of iron, quinine and strychnine), each 15 minims 1 (c.c.) of which contains about $1\frac{1}{4}$ grains (0.08 Gm.) of soluble ferric phosphate, 2 grains (0.12 Gm.) of quinine phosphate, and $\frac{1}{80}$ grain (0.0008 Gm.) of strychnine. Dose, 15 minims (1 c.c.).

Following are preparations of nux vomica and strychnine recognized in the National Formulary:—

Fluidextractum nucis vomicae, N. F. (fluidextract of nux vomica), made by digestion of nux vomica with a mixture of 3 volumes of alcohol with 1 of water, followed by percolation. The fluidextract is required to yield, from 100 c.c., 2.37 to 2.63 Gm. of the alkaloids of nux vomica, i.e., approximately 1 per cent. of strychnine. Dose, 1 to 3 minims (0.06 to 0.2 c.c.).

Elixir ferri, quininae et strychninae, N. F. (elixir of iron, quinine and strychnine), each fluidram (4 c.c.) of which contains about $7\frac{1}{8}$ minims (0.5 c.c.) of tincture of ferric citrochloride, $\frac{1}{2}$ grain (0.03 Gm.) of quinine hydrochloride, and $\frac{1}{100}$ grain (0.0007 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir phosphori et nucis vomicae, N. F. (elixir of phosphorus and nux vomica), each fluidram (4 c.c.) of which contains about $\frac{1}{70}$ grain (0.001 Gm.) of phosphorus and 2 minims (0.14 c.c.) of tincture of nux vomica. Dose, 1 fluidram (4 c.c.).

Pilulae aloes et podophylli composita, N. F. (compound pills of aloes

and podophyllum), each pill containing about 1 grain (0.06 Gm.) of aloes, $\frac{1}{2}$ grain (0.03 Gm.) of resin of podophyllum, and $\frac{1}{4}$ grain (0.016 Gm.) each of extract of nux vomica and extract of belladonna. Dose, 1 pill.

Pilulae ferri, quininae, aloes et nucis vomicae, N. F. (quadruplex pills) each containing about 1 grain (0.65 Gm.) of dried ferrous sulphate, quinine sulphate, and aloes, $\frac{1}{4}$ grain (0.016 Gm.) of extract of nux vomica, and extract of gentian, a sufficient quantity. Dose, 1 pill.

Elixir cinchonae alkaloidorum, ferri et strychninae, N. F. (elixir of cinchona alkaloids, iron and strychnine), each fluidram (4 c.c.) containing, with small quantities of cinchona alkaloids, 2 grains (0.14 Gm.) of soluble ferric phosphate and $\frac{1}{100}$ grain (0.0007 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir cinchonae alkaloidorum, ferri, bismuthi et strychninae, N. F. (elixir of cinchona alkaloids, iron, bismuth and strychnine). Same ingredients as the preceding, with the addition, in each fluidram (4 c.c.), of $3\frac{3}{4}$ minims (0.26 c.c.) of glycerite of bismuth. Dose, 1 fluidram (4 c.c.).

Elixir ferri pyrophosphatis, quininae et strychninae, N. F. (elixir of ferric pyrophosphate, quinine and strychnine), each fluidram (4 c.c.) of which contains about 2 grains (0.14 Gm.) of ferric pyrophosphate, $\frac{1}{2}$ grain (0.035 Gm.) of quinine sulphate, and $\frac{1}{125}$ grain (0.00056 Gm.) of strychnine. Dose, 1 fluidram (4 c.c.).

Elixir ferri, quininae et strychninae, N. F. (elixir of iron, quinine and strychnine), each fluidram (4 c.c.) of which contains about $7\frac{1}{8}$ minims (0.5 c.c.) of tincture of ferric citrochloride, $\frac{1}{2}$ grain (0.035 Gm.) of quinine hy-

drochloride, and $\frac{1}{100}$ grain (0.0007 Gm.) of strychnine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir pepsini, bismuthi et strychninae, N. F. (elixir of pepsin, bismuth and strychnine), each fluidram (4 c.c.) of which contains about $\frac{1}{2}$ grain (0.034 Gm.) of pepsin, $7\frac{1}{2}$ minims (0.5 c.c.) of glycerite of bismuth, and $\frac{1}{100}$ grain (0.0007 Gm.) of strychnine. Dose, 1 fluidram (4 c.c.).

Syrupus ferri, quinine et strychninae phosphatum, N. F. (syrup of the phosphates of iron, quinine and strychnine), each fluidram (4 c.c.) of which contains about $1\frac{1}{6}$ grains (0.08 Gm.) of soluble ferric phosphate, $17\frac{1}{10}$ grains (0.12 Gm.) of quinine phosphate (anhydrous), and $\frac{1}{80}$ grain (0.0009 Gm.) of strychnine phosphate (anhydrous). Dose, 1 fluidram (4 c.c.).

Syrupus hypophosphitum compositus, N. F. (compound syrup of hypophosphites), containing in every 2 fluidrams (8 c.c.) about $\frac{1}{80}$ grain (0.0009 Gm.) of strychnine and $\frac{1}{8}$ grain (0.009 Gm.) of quinine, in addition to a mixture of the hypophosphites of calcium, potassium, sodium, iron, and manganese, some hypophosphorous acid, and some sodium citrate. Dose, 2 fluidrams (8 c.c.).

Syrupus phosphatum cum quinina et strychnina, N. F. (syrup of phosphates with quinine and strychnine), each fluidram (4 c.c.) of which represents about $\frac{1}{4}$ grain (0.015 Gm.) of quinine hydrochloride, $\frac{1}{125}$ grain (0.00056 Gm.) of strychnine nitrate, 2 grains (0.14 Gm.) of calcium phosphate, and 1 grain (0.07 Gm.) each of ferric phosphate and ammonium phosphate. Dose, 1 fluidram (4 c.c.).

Strychnina, N. F. (strychnine; strychnia) [$C_{21}H_{22}N_2O_2$], an alkaloid occurring in colorless prismatic crystals

or as a white crystalline powder. While odorless, strychnine has an intensely bitter taste, perceptible in a solution as dilute as 1:700,000. One Gm. is soluble in 6420 c.c. of cold water, in 136 c.c. of alcohol, and in 5 c.c. of chloroform; very slightly soluble in ether. Dose, $\frac{1}{100}$ to $\frac{1}{15}$ grain (0.0006 to 0.004 Gm.); average, $\frac{1}{40}$ grain (0.0015 Gm.).

Strychnine arsenate [$C_{21}H_{22}N_2O_2 \cdot H_3AsO_4 + \frac{1}{2}H_2O$], an unofficial salt of strychnine, occurs as a white, crystalline bitter-tasting powder, soluble in 14 parts of water. Dose, $\frac{1}{60}$ to $\frac{1}{15}$ grain (0.001 to 0.004 Gm.).

Brucine, the secondary alkaloid of nux vomica and ignatia, is not official. It occurs in white crystals having the chemical composition, $C_{23}H_{26}N_2O_4 \cdot 4H_2O$, soluble in alcohol and chloroform, but insoluble in water. Salts of the alkaloid, such as the hydrochloride, nitrate, and sulphate, which are soluble in water, are also commercially available. Dose, $\frac{1}{12}$ to $\frac{3}{4}$ grain (0.005 to 0.05 Gm.).

MODES OF ADMINISTRATION.—Strychnine salts may be given in solution by mouth or rectum or injected subcutaneously or intramuscularly.

To obtain tonic effects either strychnine or nux vomica may be given by mouth in a fluid preparation or in capsules, pills or tablet triturates. To secure the effect of the drug as a bitter, tincture of nux vomica, administered in water ten or fifteen minutes before meals, is generally given preference. Ascending doses of strychnine are frequently employed for tonic effects; after reaching the maximum amount and continuing it for a short period, the dosage is usually brought down again gradually.

In giving strychnine sulphate in ascending doses, hypodermically, for tonic purposes, the author uses a 1 per cent. solution and administers initial doses of 0.003 Gm. ($\frac{1}{20}$ grain) in women and 0.004 Gm. ($\frac{1}{15}$ grain) in men. These are increased daily by 0.0005 Gm. ($\frac{1}{200}$ grain) until the limit of tolerance is reached, as shown by a feeling of slight intoxication, mild vertigo, stiffness of the jaw, or rigidity in the lower extremities. This reaction generally appears at 0.005 to 0.006 Gm. ($\frac{1}{12}$ to $\frac{1}{10}$ grain) in women and 0.006 to 0.007 Gm. ($\frac{1}{10}$ to $\frac{1}{8}$ grain) in men. The same dose is then injected on successive days until the effects are no longer produced, when a further increase in the dose is begun, more gradually, however, than before, *e.g.*, by 0.00025 Gm. ($\frac{1}{250}$ grain) only, or less, according to the subjective condition. The dose may thus be increased to 0.01 or 0.02 Gm. ($\frac{1}{10}$ or $\frac{1}{5}$ grain), which may even be repeated once or twice in a single day, for six hours; after each injection all summation of effect disappears. Such medication is indicated in neurasthenic states. Far from causing restlessness, the injections quiet psychic activity, relieve anxiety, and restore sleep. In simple **neurasthenia** permanent recovery usually takes place in from ten days to two weeks. In pseudoneurasthenia, however, the product of autosuggestion, and in mild forms of melancholia, frequently confounded with neurasthenia, strychnine is powerless, though harmless, and serves merely to point out the line of treatment to be followed, *viz.*, suggestion. Other conditions in which strychnine is valuable are spinal and neural affections leading to **hypotonia** and **atrophy**, **tabes dorsalis**, **cachexias**, **convalescence**, **tuberculous disease**, etc. Contraindications are few, and in giving numerous injections the author has seen no untoward result. That there is no tendency to habit-formation is shown in that the giving of 0.02- and 0.03- Gm. ($\frac{1}{5}$ and $\frac{1}{3}$ grain)

doses could be quite abruptly broken off with impunity. P. Hartenberg (Presse méd., Jan. 25, 1913).

The author has given daily doses of 0.02, 0.03, and even 0.04 Gm. ($\frac{1}{5}$, $\frac{1}{3}$, and $\frac{2}{3}$ grain) of strychnine without even witnessing any serious untoward effect. The larger the dose given the more marked the therapeutic results. He has given strychnine to many heart cases without untoward phenomena. In a case of **syphilitic myelitis** 0.015 Gm. ($\frac{1}{4}$ grain) was given daily for two months, then 0.024 Gm. ($\frac{1}{3}$ grain) for six weeks, and finally 0.03 Gm. ($\frac{1}{2}$ grain) for nearly a year, without unpleasant effects. In conjunction with small doses of mercury cyanide, intravenously, the strychnine led to a gradual disappearance of bladder and locomotor paralysis. A dosage of 0.02 to 0.035 Gm. ($\frac{1}{5}$ to $\frac{1}{2}$ grain) daily gives the best results; this amount may be attained in a few days, and only exceptionally gives rise to a sense of mild "intoxication," with slight headache and muscular rigidity. These promptly disappear if the dose is even slightly diminished. In marked **collapse** and **acute lung edema**, 0.01 Gm. ($\frac{1}{10}$ grain) and even 0.015 Gm. ($\frac{1}{4}$ grain) may be injected at a dose, to be repeated, if required, in three, four, or five hours. In **alcoholics**, as much as 0.04 or 0.05 Gm. ($\frac{2}{5}$ to $\frac{1}{2}$ grain) may be given in twenty-four hours. Strychnine nitrate is preferable to the sulphate in that it contains 6 per cent. more of the pure alkaloid, and is anhydrous, and therefore invariable in strength, whereas the sulphate varies in activity according to whether it has effloresced or not, and the amount of water of crystallization it has taken up in separating from its solutions. The author gives, to accustomed individuals, 0.008 to 0.12 Gm. ($\frac{1}{8}$ to $\frac{1}{2}$ grain) of strychnine in pill form during or after each meal. For **alcoholics**, and in cases of **infectious disease** where temporarily the heart must be sustained and general depression combated with drugs, and

where caffeine, camphor, ether, and epinephrin seem the only resources left, strychnine in full doses is a valuable reserve measure. P. Troisfontaines (Presse méd., March 29, 1913).

Children, owing to the relatively great sensitiveness of their spinal cord, are more readily influenced by strychnine than adults. The dosage should therefore be somewhat smaller. For a child of 5 or 6 years, the initial dose should not exceed $\frac{1}{100}$ grain (0.0006 Gm.).

INCOMPATIBILITIES.—Strychnine salts are incompatible with iodides, bromides, and ammonium chloride; with alkalies, alkali carbonates and bicarbonates; with benzoates, salicylates, dichromates, and cyanides; with tannic acid, and with oxidizing agents in general. They may be successfully combined with potassio-mercuric iodide by the addition of acacia (gum arabic).

CONTRAINDICATIONS.—Strychnine is contraindicated in acute inflammatory states of the spinal cord, including epidemic poliomyelitis, in acute and subacute neuritis, and whenever the reflexes are already exaggerated. In neurotic individuals who are introspective along sexual lines strychnine should not be given. In patients with thickened, tortuous blood-vessels and in sclerotic nephritis, chronic gout, and syphilis in its later stages, some caution should be exercised. Where cerebral hemorrhage threatens the drug is, of course, absolutely contraindicated. As a rule, strychnine should be withheld in neurotic or hysteric persons until some definite occasion for its use, such as exhaustion due to an intercurrent condition, arises.

In children it should be borne in mind that long-continued administrc-

tion of strychnine or nux vomica may bring on a state of peevishness, talkative delirium, or even temporary insanity.

PHYSIOLOGICAL ACTION.—

The action of strychnine, the chief alkaloid of nux vomica, may be taken as practically representing that of the entire crude drug, brucine having only a relatively feeble influence, and one which in the main merely reinforces the action of the strychnine.

Externally, strychnine exerts only a slight irritant action.

General Effects.—*Nervous System.*—Strychnine causes a pronounced increase in reflex excitability, particularly in the spinal cord, to a less extent in the brain. From its action on the cerebrum there results an increase in the processes of intellection, and a slight diminution in mental fatigue; these effects, however, are not nearly as pronounced as in the case of caffeine. Strychnine, by stimulating all perceptive centers, including those concerned with the special senses, augments tactile and pain sensation and increases the acuteness of the senses of hearing, smell, and taste. Vision also becomes keener, especially in the distinction of different colors. Since the latter influence is exerted even upon mere instillation of a solution of the drug in a single eye, in which case the effect is limited to that eye, the action in this respect is believed to take place at least in part in the retinal cells, which the drug reaches through the lymphatics.

In respect of the spinal cord, small doses of strychnine cause merely an exaggeration of the motor response normally resulting from a sensory stimulus received at the surface of the body and transmitted to the spinal cord

through the sensory nerves. Larger doses cause muscular twitchings or actual convulsions. That these convulsions are due to excitation of spinal motor activity rather than to an influence on motor cells in the brain is suggested by the fact that the four limbs generally go into convulsions simultaneously, and is positively proved by the observation that cutting the spinal cord—*c.g.*, in the frog—does not prevent convulsions in muscles supplied from nerve-cells in the cord below the point cut. In truth, there is no satisfactory evidence that the motor nerve-cells are stimulated by strychnine in the brain.

Experimental work in animals has seemed to show that powerful stimulation of the sensory cells is the most important of the nervous effects of this alkaloid. The sensory side of the spinal cord is rendered so sensitive that even a slight stimulus from the skin surface brings about a motor response of the entire cord, manifested in a general tonic spasm. The drug not only facilitates the passage of a sensory impulse to the special group of motor cells normally reached from the application of a stimulus to a given locality, but also tends to open up paths to other motor cells, so that cells normally uninfluenced by a stimulus respond readily where strychnine has been employed. Where the dose given is not sufficient to produce twitchings, motor response, while more intense than normally, does not lose its purposive character; where, on the other hand, a convulsive dose is administered, all purposive reflex activity is interfered with, and co-ordinated reflex actions, in which, when one group of muscles contracts, inhibition of the opposing muscles

occurs, can no longer take place; in fact, the normal inhibition of opposing muscles is replaced by excitation, the result being a spastic condition.

When the lower half of the spinal cord is poisoned by the transfusion method, spasms confined entirely to the lower half of the animal occur when the skin of that region is stimulated. The spasms then become spontaneous in the lower half of the animal. As the poisoning increases the spasms become general, occurring in the upper unpoisoned half when the lower half is stimulated. Spontaneous general spasms then ensue. If at this stage the spinal cord is cut at a level just between the poisoned and unpoisoned portions, the spasms cease in the upper half of the animal, while they continue below, indicating that the upper half is unpoisoned. An injection of strychnine subsequently into the upper part of the animal again throws it into spasms. A. H. Ryan and H. McGuigan (*Jour. of Pharm. and Exp. Therap.*, Mar., 1911).

Strychnine acts on both motor and sensory neurons, and no tetanus can develop from its action unless the motor neuron is directly acted on by it. McGuigan and Becht (*Jour. of Pharm. and Exp. Ther.*, May, 1914).

Strychnine and physostigmine stimulate the intestine and uterus in cats, but as they also stimulate the adrenal glands, increasing the output of epinephrin, to which the intestine is extremely sensitive, the intestinal activation may be counteracted by the added epinephrin. The same applies, in a less degree, to the uterus. Strychnine and physostigmine probably do not act solely on the sympathetic terminals, as is generally held, but on various tissues of the body. C. W. Edmunds (*Jour. of Pharm. and Exp. Ther.*, Jan., 1923).

Strychnine, in common with physostigmine and, to a less extent, pilocarpine, has been shown to increase the amount of epinephrin in the blood. The epinephrin is increased

by strychnine even in therapeutic doses. In dogs, small doses of epinephrin produce an increase in the number of leukocytes, followed by a decrease of the lymphocytes and later of the polynuclears. Strychnine was found to affect the leukocytes in a manner similar to the small doses of epinephrin. In adrenalectomized dogs the leukocyte curves after strychnine were very different, showing a reduction from the start, which indicates that in normal animals strychnine acts on the blood-picture through adrenal stimulation. Sodium luminal was found, by acting as depressant, to interfere with the effects otherwise produced by strychnine. C. W. Edmunds and P. C. Lloyd (Jour. of Lab. and Clin. Med., June, 1923).

On the centers in the medulla oblongata strychnine frequently exerts a well-marked stimulant action, which, however, rather readily gives way to depression where an excessive dose has been used. In strychnine poisoning death in some instances is caused by this secondary depression of the medullary centers.

On the peripheral nervous structures—nerve-trunks and nerve-endings—strychnine has no influence in man, though in frogs poisoned with it a curare action—paralysis of motor nerve-endings—is at times discernible.

Circulation.—In therapeutic doses, strychnine has been claimed to stimulate the vasoconstrictor and vagus centers in the medulla, thus causing at times a slight rise in blood-pressure and a slight slowing of the pulse rate. In perfusion experiments on the mammalian heart little or no evidence of a direct stimulant action on this organ by moderate amounts has been obtained, yet from clinical observation in certain cardiac cases strychnine has been credited with a tonic influence upon the heart muscle.

Clinical tests of the effect of ordinary doses of strychnine on blood-pressure have yielded varying results. According to Cook and Briggs there is no effect on the pressure under normal conditions, but in ill persons a gradual rise in pressure results, lasting from one to four hours.

With toxic doses of strychnine the vasoconstrictor and vagus centers are finally depressed. During convulsions the blood-pressure is greatly increased, not through any direct effect of the drug on the vessel walls, but by reason of the pressure exerted on the vessels by the violently contracting muscles.

Toxic doses of strychnine may be administered at short intervals during periods up to 12 days, the total being 25 times the single fatal dose, without causing perceptible lasting effects. Only a small percentage of the strychnine so administered can be recovered from the urine, and none from the feces. The excretion in the urine usually ceases within 24 to 48 hours. The experiments indicated that strychnine was rapidly destroyed in the bodies of animals, particularly in the liver. Hatcher and Eggleston (Jour. of Pharm. and Exper. Therap., Oct., 1917).

Respiration.—Strychnine frequently acts as a strong stimulant to the respiratory centers in the medulla, the breathing being increased both in rate and amplitude by large therapeutic doses. This action is asserted to occur mainly, however, where the excitability of the center is depressed previous to its administration. In experiments on dogs, Wood recorded a 75 to 300 per cent. increase in respiratory air movement under strychnine. The irritability of the centers implicated in cough is likewise increased; where there is inability to cough up excessive

secretions, strychnine may therefore be used to render cough more effectual. In addition, strychnine tends to tone up the bronchial musculature, and can thus be administered with advantage where the bronchi are relaxed.

Reports of experiments with strychnine on healthy students. The drug was given hypodermically in doses of $\frac{1}{40}$, $\frac{1}{30}$ and $\frac{1}{20}$ grain (0.001, 0.002, 0.003 Gm.). It had no effect on the rate of respiration, except in the dose of $\frac{1}{20}$ grain (0.003 Gm.), which produced an average increase of one per minute; this effect varied markedly in the different students, a drop in the rate occasionally occurring without apparent cause. A slowing of the pulse rate resulted from all doses, and a marked increase in blood-pressure from the $\frac{1}{30}$ - and $\frac{1}{20}$ -grain (0.002 and 0.003 Gm.) doses. David Marvin (Arch. of Internal Med., April, 1913).

Toxic doses of strychnine may kill either through excessive excitation of the respiratory centers, the respiratory muscles being thrown into a condition of spasm and therefore of functional inefficiency, or through secondary exhaustion of the same centers, death taking place similarly from asphyxia.

Alimentary Tract.—Here strychnine produces effects both locally and after absorption into the general system. The initial effect is that of a bitter, the intense bitter taste of the alkaloid stimulating the taste buds in the mouth, and thereby restoring appetite where lost and exciting a flow of the "appetite" or "psychic" gastric juice. The bitterness also causes a reflex flow of saliva. Both the amount and the digestive power of the gastric juice have been found to be increased by strychnine. In the intestine it stimulates peristalsis,—an effect presumed

to be due to an increase in the irritability of the local nerve-centers governing peristalsis, viz., the ganglion cells of the plexus of Auerbach. Augmented secretory activity through reflex action—an effect analogous to the augmented motor activity (convulsions) resulting from stimulation of the spinal sensory cells under the influence of large doses—is also considered to be, in all probability, one of the beneficial actions of strychnine. An increase in the tone of the gastric and intestinal muscles is, furthermore, ascribed to the effect of strychnine upon the spinal cord after its absorption.

Muscles.—Strychnine has no direct action on muscle tissue, but promotes muscular power by increasing the tone of the nerve-centers supplying muscle tissue and augmenting reflex activity.

Metabolism.—Strychnine causes an increase in metabolism through the improvement of tone it occasions in muscle tissue by reason of its influence on the spinal nerve-cells. Oxygen consumption and liberation of carbon dioxide are both increased.

Temperature.—A slight increase of body temperature may take place under strychnine owing to augmented heat production in the muscles; this augmented heat production seems, however, usually to be compensated for by dilatation of the skin vessels, heat dissipation being thereby increased sufficiently to keep the temperature quite constant.

Absorption and Elimination.—Absorption of strychnine from the stomach and especially from the intestine is rather rapid. A portion of the drug absorbed is destroyed in the system, but a considerable remainder is eliminated through the kidneys and also with the sweat, saliva, and bile. Elimination

nation begins promptly, and most of the drug taken in is gotten rid of within twelve hours; the residual amount, however, may be present in the urine for four, five, or even eight, days. In the urine strychnine appears both as such and in the form of strychnic acid, an oxidation product of strychnine.

Tests with oral or intramuscular administration of 0.004 Gm. ($\frac{1}{16}$ grain) of strychnine showed that the kidneys excrete 20 per cent. of single doses, but a much lower percentage of large amounts taken by mouth over periods of 12 to 24 hours. The kidneys excrete only what the liver fails to excrete. S. Weiss and R. A. Hatcher (Jour. of Pharm. and Exp. Ther., July, 1922).

Brucine.—Brucine is many times weaker than strychnine as a convulsant, though resembling it in its action in a general way. In addition it possesses a distinct local anesthetic action in 5 or 10 per cent. solutions.

UNTOWARD EFFECTS AND POISONING.—The preliminary signs of strychnine poisoning may be witnessed when this alkaloid or nux vomica is given in rapidly ascending or unnecessarily large repeated doses, and consist in restlessness and nervousness, exaggerated reflexes, muscular twitchings, and sometimes a feeling of rigidity in the neck or stiffness in walking. Sensations of stiffness in the facial muscles, particularly in laughing, or in the throat, jaws, or chest may also be experienced. Sudden movements, such as shrugging of a shoulder, or abrupt jerking of an arm or leg, are additional rather characteristic manifestations. Formication and other paresthesias have been noted in some cases of incipient strychnine poisoning.

After large toxic doses of strychnine have been taken symptoms usually appear in from fifteen to twenty minutes, rarely later than an hour, and often with great suddenness. Sometimes the convulsions are preceded by partial spasms of the muscles of the extremities, but frequently the patient is suddenly thrown down in a general tetanic spasm. The condition is then one of profound opisthotonos, the body being bent backward and resting upon the heels and head. The legs are extended, the feet everted, the arms bent, and the hands clenched. The eyes, staring, are wide open, and the corners of the mouth are drawn up (*risus sardonicus*). The face is at first pale, but may become livid from interference with respiration. Consciousness is not affected unless asphyxia is so pronounced as to threaten death. The senses are often more acute than normally, but tinnitus and amaurosis may be present if the paroxysms are severe. The muscles of the jaw are generally the last in the body to become affected, but trismus finally comes on in severe cases, and in a certain proportion of instances appears early in the course of the poisoning. While death may occur in the first convulsion in animals, no instance of such prompt death has been recorded in man (Tardieu).

After a shorter or longer time muscular relaxation sets in and a period of calm ensues, to be succeeded by a second convulsion. The slightest noise, draught of air, or touch may cause a convulsion or series of convulsions, the sensory impulse reaching the spinal cord causing exaggerated motor impulses to be sent out to the muscles. A firm grasp or hard

rubbing of the muscles is frequently grateful to the patient under these circumstances. During the spasms progressive asphyxia develops, the respiratory muscles being in a state of tetanic rigidity; during the periods of relaxation, on the other hand, the patient breathes easily, except when secondary depression of the respiratory centers has become pronounced. A slight rigidity is sometimes present during the periods of relaxation, but no marked stiffness. The cramp-like contraction of the muscles is generally, but not always, very painful. Erections of the penis are not infrequent, and the urine and feces may be voided involuntarily.

If the case is to terminate favorably, the convulsions gradually lessen in severity and finally cease, leaving the patient exhausted, with a sore, tired feeling in the muscles from overcontraction. Death, if it occurs, takes place usually within two hours, either from cramp asphyxia (rigidity of the respiratory muscles) or from exhaustion or secondary depression of the medullary centers. The heart may continue beating for a time after breathing has stopped. Post-mortem examination reveals the usual congestive lesions of death by asphyxia, as well as, at times, indications of spinal hyperemia. In cases that recover, albuminuria is at times noted for a short period.

Strychnine is an extremely permanent body, and has been recovered from the tissues eleven years after burial. The tissues in which it has been commonly found in quantity, besides the contents of the stomach and urinary bladder, are the liver and kidneys.

The post-mortem appearances considered to be in accordance with, if

not characteristic of, poisoning by strychnine, are: (1) The usually rapid onset of cadaveric rigidity. (2) The evidences of death during a convulsive seizure; the lips may sometimes bear evidences of having been bitten. (3) The mottling of dependent parts. (4) Internally, the blood is fluid and of a very dark color. (5) General congestion of internal organs, especially marked in the meninges and cortex of the brain and spinal cord. (6) The left ventricle of the heart invariably empty and contracted, and the right ventricle containing but a small amount of blood, and that fluid. (7) The stomach unaffected internally. H. A. Spencer (Transvaal Med. Jour., May, 1908).

The minimum fatal dose of strychnine is generally placed at about $\frac{1}{2}$ grain (0.03 Gm.). Incipient toxic effects were noted in a woman who had taken $\frac{1}{12}$ grain (0.005 Gm.). One one-hundredth of a grain (0.00065 Gm.) is said to have killed a child $3\frac{1}{2}$ months old; 10, 20, and 22 grains (0.6, 1.3, and 1.4 Gm.), taken upon a full stomach and retained two hours, failed to cause death in each case, probably on account of slow absorption (Wood). Tolerance to the drug, established through gradually ascending dosage, will, of course, increase the minimum lethal quantity; $\frac{1}{4}$ grain (0.05 Gm.) in a day is easily borne where tolerance has been developed.

Diagnosis of Strychnine Poisoning.

—Strychnine poisoning may be confounded with tetanus. The convulsions of strychnine poisoning do not resemble those of epilepsy, as they are distinctly tonic and never clonic.

In *tetanus* the locking of the jaws (trismus) comes first; in strychnine poisoning it usually comes last. The convulsions of tetanus rarely, if

ever, completely relax; in strychnine poisoning periods of relaxation occur. In tetanus there is usually the history of an injury, or of a rusty nail or needle run into the foot or other part of the body. The more prolonged course of the disturbance present may also at times be available as a diagnostic indication.

Treatment of Strychnine Poisoning.—If no symptoms have appeared, the first measure adopted should be to **wash out the stomach** thoroughly. The chemical antidotes—as **tannic acid** (30 grains; 2 Gm.), **strong tea** (*ad libitum*), **Lugol's solution** (1 fluidram; 4 c.c.), or **potassium permanganate** (generous amounts of a 1:1000 solution)—may now be administered, but should be followed by a quickly acting **emetic** or the use of a **stomach tube**, as the compounds formed by these substances are not permanent. **Potassium bromide** ($\frac{1}{2}$ ounce—15 Gm.) combined with **chloral hydrate** ($\frac{1}{2}$ to 1 dram—2 to 4 Gm.) should be given, and every twenty minutes afterward, if necessary, 2 drams (8 Gm.) of the bromide, and 15 grains (1 Gm.) of chloral. The bromide and chloral are physiological antidotes, the former depressing especially the sensory side of the cord, and the latter the motor side. **Powdered charcoal** has been credited with some value as an absorbent of the poison in the stomach.

Where convulsions have already appeared when the case is seen, immediate **inhalation of chloroform** or **ether** is indicated, these agents, as strong depressants to the spinal cord, counteracting the exciting effect of strychnine. Chloroform, acting rapidly, may with advantage be administered first, and ether later substituted

for it in view of its less harmful action on parenchymatous organs where prolonged anesthesia is required. **Amyl nitrite** may also be used in strychnine convulsions, preferably by **inhalation**, but is decidedly less effective than the general anesthetics mentioned. It should be borne in mind, however, that anesthetic drugs must be used carefully in strychnine poisoning, as both chloroform and ether tend to augment the muscular relaxation customarily present between the convulsions, and especially since chloroform tends to depress further the already paretic respiratory center during the same intervals. The same drawback obtains in the case of chloral hydrate, the action of which must, therefore, be closely watched. Bastedo suggests that **paraldehyde**—less depressing to the respiration—be substituted for chloral hydrate. The anesthetics administered by inhalation are advantageous in that when depression appears their action can be discontinued more promptly than in the case of chloral and bromides.

When the convulsions have been brought under control, and while the patient is still under the influence of the anesthetic, a stomach-tube should be introduced and the stomach washed out with a warm solution of 1:1000 **potassium permanganate**. If chloral and bromides have not yet been administered, they may now be given in full yet not exaggerated amounts,—*e.g.*, 30 grains (2 Gm.) of **chloral** and 2 drams (8 Gm.) of **potassium** or **sodium bromide**, either by mouth or rectum,—to prolong the effect of the anesthetic. In determining the doses to be administered, the condition of the patient at the

time and the degree of likelihood of subsequent serious respiratory and circulatory depression should be thought of. To hasten elimination of the strychnine absorbed into the system **intravenous saline infusion**, causing free diuresis, and **catheterization** of the bladder, to remove the strychnine carried into the latter, have been strongly advised. Githens and Meltzer, from experimental work, recommend **ether anesthesia**, **intra-tracheal insufflation**, and **intravenous infusion of Ringer's solution** as the three most effectual therapeutic measures in strychnine poisoning.

A large man suffering from lymphatic leukemia received through error one morning 15 grains (1 Gm.) of strychnine sulphate in three capsules. The patient was found rigidly extended on his bed, conscious, extremely apprehensive, and complaining of intense pain in the back of the neck. From time to time his muscular rigidity increased suddenly. He was immediately given $\frac{1}{4}$ grain (0.016 Gm.) of **morphine**. A few minutes later, on attempting to pass a tube, it was found that the patient could not separate his jaws more than half an inch. The trismus rapidly increased and the patient passed into a severe tonic convulsion with cessation of respiration and intense cyanosis. Efforts made to open the mouth with a gag during the convulsion were unavailing. One-tenth grain (0.006 Gm.) of **apomorphine** was injected. Shortly after, the **stomach-tube** was successfully passed through a nostril and the stomach thoroughly washed out. The patient vomited milk curds repeatedly during this washing. The washing was repeated several times. Shortly after the second severe general convulsion, **chloroform anesthesia** was started. This was changed to **ether** an hour later, and the patient was kept continuously under the anesthetic for five and a

half hours more. An enema containing 40 grains (2.6 Gm.) of **sodium bromide** and 20 grains (1.3 Gm.) of **chloral hydrate** was early given. No further severe convulsions occurred, but milder convulsive movements were noted. Two drops of **croton oil** failed to act.

Urine was obtained by **catheter**. A pint of **saline solution**, with 10 grains (0.6 Gm.) of **diuretin**, was given by **rectum**, and this was repeated about once in two hours until noon of the following day. A flood of urine and numerous small stools were passed during the night. Repeated twitchings of the muscles were noted up to midnight. On the following morning the patient complained of soreness of the muscles. For several nights he was restless, and complained of muscular twitchings. Over $1\frac{3}{4}$ grains (0.104 Gm.) of strychnine were recovered from the urine of this patient. During the earlier stages of the poisoning the amount of urine was diminished, and very little strychnine excreted. Hewlett (Amer. Jour. Med. Sci., Oct., 1913).

A study in a human case and in animals showed that **magnesium sulphate**, given intraspinally, 1 c.c. (15 minims) of a 25 per cent. solution to each 20 pounds in adults, and $\frac{1}{2}$ of the dose in children, tends to control strychnine convulsions. Cutler and Alton (Jour. Exper. Med., Jan., 1917).

Throughout the course of the poisoning an absolutely quiet environment is to be sought for the patient, as even the slightest sensory stimuli, *e.g.*, touch or manipulation, a suddenly projected light, a draught of air or a sharp noise, will tend to bring on, in the unanesthetized patient, a convulsive attack. **Morphine** may be used in strychnine poisoning to relieve pain during the convulsive periods, but considerable caution in the dosage is necessary, in view of the well-known depressant effect of morphine on the respiratory center.

Nicotine and a **tobacco enema** have been used with apparent efficacy in strychnine poisoning, and **veratrum viride** in the dose of 1 fluidram (4 c.c.) of the tincture, followed by 2 drops every ten minutes, was credited by Ringer with having cured a bad case, but the uncertainty of action of the first-named drug, and the probable harmful influence of veratrum on the circulatory condition in the later stages of the poisoning, are serious drawbacks. **Physostigmine salicylate** or **sulphate** in doses of $\frac{1}{30}$ grain (0.002 Gm.) or more is likely to prove more useful than either nicotine or veratrum. Batson administered two hypodermic injections of $\frac{1}{24}$ grain (0.0025 Gm.) of **pilocarpine hydrochloride** in a case of strychnine poisoning in a 2½-year-old child, sedation of the (clonic) convulsions and recovery following. Turner noted the favorable influence of ingesting large amounts of **lard** in experimental strychnine poisoning.

Artificial respiration, oxygen inhalations, and external heat are considered of value chiefly in cases that reach the secondary phase of depression and exhaustion of the vital centers and circulation, though, according to Gies and Meltzer, artificial respiration is useful to postpone the beginning of convulsions, and oxygen inhalations may be employed both immediately after convulsions to relieve the cyanosis and partial asphyxia resulting from the stoppage of respiration during the spasm, and to enhance the oxidation of strychnine in the system. Artificial respiration by the ordinary manual methods is practically useless during the violent convulsions, though if suitable pumping apparatus be at hand (pul-

motor or intratracheal insufflation) the "forced" respiration thus imposed may save life. At the close of the convulsions artificial respiration may be useful in favoring the resumption of spontaneous breathing.

The authors injected twice the fatal dose of strychnine into a number of dogs and then introduced a catheter into the trachea and **etherized** the animals by the **insufflation** method. The convulsions could be very easily controlled in this way, and not one of the twenty animals died. Even where the narcosis lasted for several hours, but little ether was required. The results were not good with chloroform. T. S. Githens and S. J. Meltzer (Berl. klin. Woch., April 10, 1911).

Frogs receiving an injection of insulin were found to recover from strychnine poisoning much more rapidly. Where, however, the insulin was given only after convulsions had come on, the frogs succumbed, whereas controls recovered. Karasek (Casop. lek. cesk., Oct. 10, 1925).

Pigeons were given 10 to 20 c.c. of 20 per cent. glucose solution every hour for 3 hours, and strychnine given 4 hours later. The minimum lethal dose of strychnine given subcutaneously was raised by this procedure from 2.0 to 6.75 mgm. per kilo. Apparently the ability of the liver to disintoxicate strychnine depends to some extent on its glycogen content. Heinekamp (Jour. of Lab. and Clin. Med., Dec., 1925).

THERAPEUTICS.—As a **respiratory and circulatory stimulant**, strychnine, administered hypodermically in doses of $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003 to 0.006 Gm.), has been considered of value in shock—especially incipient cases,—in **collapse**, and in **poisoning** by various drugs, particularly hypnotics and narcotics such as **chloral hydrate, alcohol, ether, chloroform, morphine, opium, and the coal-tar analgesics**, as well as in **poisoning by**

meat, fish, cheese, or toadstools. The stimulating action of strychnine on the respiratory centers is considered especially powerful, though not very lasting. It is to be borne in mind that where sufficient strychnine is given to produce a distinct effect on the blood-pressure, a secondary depression of the vasomotor center may easily occur. Although not credited with any marked power as a direct cardiac stimulant, strychnine is used, seemingly with success, in circulatory weakness, or actual collapse occurring in **infectious diseases, e.g., bronchopneumonia, diphtheria, scarlet fever, septicemia, Rocky Mountain fever, etc.**

Large doses of strychnine may be of value in **Stokes-Adams disease.** In a case with severe symptoms of heart disease without complete degeneration, the patient had Stokes-Adams symptoms and remained with permanent heart-block for two years. The man was able to do his work during this period, with his pulse always below 30, and died suddenly one night while washing his hands. During the period referred to he was always perfectly well, provided he was taking $\frac{1}{20}$ grain (0.003 Gm.) of strychnine. If he went without it, his pulse would intermit for one-fourth of a minute. George Dock (Jour. Amer. Med. Assoc., June 22, 1912).

In a few cases of **pneumonia, typhoid fever, and heart disease,** the author observed well-marked favorable changes in the heart sounds and pulse after the use of strychnine. He also noted similar changes in a patient with phthisis, who took $\frac{1}{80}$ grain (0.002 Gm.) three times a day for several days. The heart sounds in this patient were considerably louder than normal, the second aortic being especially accentuated, and the pulse bounding. The author hesitates to believe that there are no con-

ditions in which strychnine is of value as a stimulant. G. C. Shattuck (N. E. Pediatric Soc.; Merck's Archives, July, 1913).

The direct stimulating effect of strychnine on the respiratory centers is also availed of in respiratory affections associated with **dyspnea** and perhaps **cyanosis**, as in **emphysema** and **hypostatic lung congestion**, or with **insufficient cough**, and the consequent **insomnia.** Thus, in **bronchitis** or **pulmonary tuberculosis** with much bronchial secretion, but a weak, ineffectual cough, strychnine may be indicated to augment the intensity of the coughing reflex. In the later stages of **pneumonia**, especially when collapse threatens, the combined circulatory and respiratory stimulant effects of strychnine are frequently of value. In **Asiatic cholera** or **bacillary dysentery** with threatening collapse, as well as in **summer diarrhea** with watery diarrhea, combined administration of nux vomica, opium, and mineral acids has been strongly recommended. If there be much pain, the following formula may be used:—

℞ *Strychninæ sulphatis* gr. $\frac{1}{4}$ (0.015 Gm.).
Acidi sulphurici diluti ℥ss (15 c.c.).
Morphinæ sulphatis. gr. ij (0.12 Gm.).
Aqua camphoræ .. ℥iiss (100 c.c.).

M. Sig.: One teaspoonful every hour or two, well diluted.

Strychnine should be given in much larger doses than is customary. The author cured an **acute edema of the lungs** in a gouty subject by giving $\frac{1}{8}$ grain (20 mg.) of sulphate of strychnine in one hypodermic injection, and continuing to give fractional doses every hour until the crisis of the attack had passed. Troisfontaines (Gaz. méd. Belge, July 4, 1907).

Strychnine should be employed much more freely than in the past, its most frequent indications being: Traumatic shock, prolonged fevers, coma from chloral, opium, or alcohol; **neurasthenia** and **infantile** spinal paralysis. In the latter disease he injects it into the spinal cord. Neisser (Berl. klin. Wochen., Jan. 21, 1918).

As **general tonics** strychnine and nux vomica are used in a great variety of disorders associated with nervous depression and general weakness. Thus in **convalescence** from severe illnesses, and in other states of **debility** with more or less pronounced **anorexia**, **feeble digestion**, and more or less coated tongue, the action of the drug on general tonicity, as well as that on the appetite, is of well-recognized value. Not only does the drug act locally as a "bitter" and stimulant to peristalsis, but by stimulating the spinal cord it causes improved general muscular tone and probably a better functioning of the various visceral organs through activation of the reflexes governing the activity of these organs.

The following combination acts as a powerful stimulant to the various functions in slow convalescence from infections:—

℞ *Strychnina sulphatis* gr. j (0.06 Gm.).
Quinina hydrochloridi 3ij (8 Gm.).
Phosphori gr. ss (0.03 Gm.).

M et fac in pilulas no. lx.
 S.: One pill after meals.

A combination of strychnine with a mineral acid and infusion of gentian is appropriate where a bitter tonic effect is especially required under the same conditions.

In mental or physical **exhaustion** due to overwork, strychnine is not

infrequently prescribed. Yet during periods of strenuous labor, strychnine can only be regarded as a temporarily acting whip to the nervous system; far preferable is its use where the period of strain is over, when restoration to the normal state may be hastened by it.

In wasting diseases, including **pulmonary tuberculosis** and **cancer**, strychnine or nux vomica is extensively used to improve the appetite and the digestive functions. In pulmonary tuberculosis it tends to prevent or relieve **night-sweats**. In the **anemias** it is also distinctly useful when employed as an adjunct to iron and arsenic. Morgan points out that in patients with a tendency to **melancholia**, with a markedly rundown system, as from poor feeding, etc., the use of strychnine in gradually ascending doses is almost invariably followed by a favorable reaction and general mental and physical improvement.

In **hemophilia**, strychnine or nux vomica may be used with benefit.

In nervous depression associated with **chronic intoxication by alcohol**, strychnine is not infrequently the remedy which will best control the morbid desire for alcoholic stimulation. Hypodermic injection of $\frac{1}{30}$ grain (0.002 Gm.) three or four times daily for a week, or possibly two weeks, will procure relief from the depression due to abstinence from alcohol preparations, partly by stimulation of the vesical functions through its effect on the spinal cord, partly by overcoming the vasomotor paresis caused by alcohol, and partly through its stomachic effect. **Tremor** in chronic alcoholics is at times checked by strychnine. In some cases, how-

ever, the spinal cord is already over-excited, as shown by unusual reflex activity (knee-jerk), and strychnine must then be used only with due caution. In **acute alcoholism**, $\frac{1}{10}$ grain (0.006 Gm.) of apomorphine hydrochloride and $\frac{1}{30}$ grain (0.002 Gm.) of strychnine sulphate form a useful combination to provoke emesis. In violent or delirious patients, $\frac{1}{15}$ grain (0.004 Gm.) of the apomorphine, combined with strychnine, will nearly always induce sedation and sleep (Blackader). In **delirium tremens**, similar combinations of strychnine with a sedative are not infrequently of value.

In **gastrointestinal disorders** nux vomica and strychnine are of decided value where improved appetite, secretion and motility are desired. Like other bitters, they produce a sensation of hunger, and, in addition, their excitant action on spinal and other reflexes tends to improve the gastrointestinal functions as a whole. In cases of **achylia gastrica** (**atrophic gastritis**) or so-called **atonic dyspepsia**, tincture of nux vomica may be given advantageously in doses of 5 to 20 minims (0.3 to 1.25 c.c.) fifteen or twenty minutes before meals. Where the stomachic effect is alone desired, 5- or 10- minim doses suffice, whereas, if increased motility is also an object in view, the larger doses are often necessary. Strychnine, $\frac{1}{60}$ to $\frac{1}{30}$ grain (0.001 to 0.002 Gm.), may be substituted for nux vomica, but is more rapidly absorbed, and its strictly local effects are, therefore, of shorter duration.

Kemp recommended the following combination in **achylia gastrica** (in **anorexia nervosa** the pepsin may be omitted):—

℞ *Tinctura nucis vomica*,
Acidi hydrochlorici
dilutiāā f3iij (12 c.c.).
Tinctura cinchonæ
composita f3j (30 c.c.).
Pepsini puri 3iiss (6 Gm.).
Aqua sterilis ..q. s. ad f3iv (125 c.c.).

M. Sig.: One or 2 teaspoonfuls in water three times daily before meals.

The same author recommends simultaneous administration of strychnine arsenate, $\frac{1}{100}$ grain (0.0006 Gm.), and quassin, $\frac{1}{10}$ grain (0.006 Gm.), for stomachic purposes. In the dyspepsia of **Addison's disease** similar treatment is indicated.

In **acute gastric catarrh** accompanied by **sick-headache**, but without much nausea, due generally to some error in diet or to constipation, prompt relief is obtained from nux vomica. One drop of the tincture in a teaspoonful of water every five or ten minutes, for eight or ten doses, and then continued at longer intervals, will often mitigate this kind of headache and in a few hours remove it. In the **gastric catarrh of alcoholics**, tincture of nux vomica is frequently of value when combined with 5 to 10 minims (0.3 to 0.6 c.c.) of tincture of capsicum. The mineral acids may also be advantageously given with it. In the **gastric irritability following acute alcoholism**, a combination of nux vomica with sodium bicarbonate is useful.

In **gastric and intestinal fermentation** the following formula has been advised by W. H. Thomson:—

℞ *Resorcinolis* 3iij (12 Gm.).
Tinctura nucis
vomica f3iv (16 c.c.).
Syrupi zingiberis ... f3ij (60 c.c.).
Aqua mentha piper-
itaq. s. ad f3viii (250 c.c.).

M. Sig.: Two teaspoonfuls in water one-half hour after meals.

Flatulence and **pyrosis** frequently yield to small doses of *nux vomica* tincture, given three or four times a day.

In **catarrhal stomatitis** and in the after-treatment of **ulcerative stomatitis**, the use of *nux vomica* has been recommended.

In **atonic conditions** of the bowels with **constipation**, strychnine or *nux vomica* are of value to improve the tone of the centers governing peristalsis, and in many instances also tend to relieve constipation by their action in improving the gastric functions. Strychnine is frequently used to assist and facilitate the action of laxatives. Thus, the *Pilulæ laxativæ compositæ* (compound laxative pills) of the N. F. contain, in addition to aloin, pilular extract of belladonna, and powdered ipecac and licorice, $\frac{1}{125}$ grain (0.0005 Gm.) of strychnine. The fluidextract of cascara sagrada, together with tincture of *nux vomica*, form a valuable laxative combination. In **epidemic dysentery** with tympanites, the use of strychnine has also been recommended.

In the condition popularly described as **hepatic torpor**, when the stools are pale in color and have an offensive odor, showing an absence of bile; when the tongue is covered with a thick fur and the patient complains of headache, lassitude, loss of appetite, and a bad taste in the mouth, small doses ($\frac{1}{60}$ grain—0.001 Gm.) of strychnine given two or three times daily will often act well as a mercurial.

In **acute catarrhal jaundice**, small doses of tincture of *nux vomica* in essence of pepsin may be given with advantage (Elsner).

Certain chronic skin affections, in-

cluding **acne**, are often benefited through the effects of *nux vomica* or strychnine on the alimentary tract.

As a direct stimulant to the activity of the spinal cord, strychnine is of value in certain forms of **paralysis**, *e.g.*, those due to alcohol, lead, pressure on nerve-trunks, and the toxin of **diphtheria**, but only where the acute inflammation of the nerve-cells or their processes has subsided. During the earlier stage of active inflammation it is, on the contrary, harmful. Its field of use lies simply in stimulation of the activity of cells the function of which has remained depressed through the effects of the acute disease. Where there is a tendency to atrophy of the muscles supplied by the affected nerves, strychnine antagonizes it, especially if used in conjunction with massage, passive movements, and electric treatment. Unusually large doses of the alkaloid, ascending to $\frac{1}{2}$ grain (0.03 Gm.) a day, as advised originally by Hammond, are not infrequently administered in these conditions, with benefit. **Tabes dorsalis** is among the states in which ascending doses of strychnine have been employed with asserted benefit, but many deny its value except as a general tonic. In **asthenic bulbar paralysis**, very small doses of strychnine are alone indicated. In **chronic ophthalmoplegia** Grinker recommends a course of strychnine in ascending dosage. In **neuritis** and **multiple neuritis** the general tonic effects of the drug are of value; likewise in some cases of **neurasthenia**. In **epidemic poliomyelitis** and **herpes zoster**, strychnine is of value only in the after-treatment.

By subcutaneous injection strychnine has a remarkable action in

overcoming the **paralysis of the bladder** accompanying advanced stages of **progressive paralysis**. The author gave from 4 to 12 injections, each of 0.02 c.c. of a 1:1000 solution, commencing at the first sign of a tendency to retention of urine, and suspending the drug as the tendency subsided, returning to it again on renewal of symptoms. In 32 cases the rapid and certain success of the injections was amply demonstrated. The strychnine seemed to have a supplementary beneficial action in warding off or hastening the healing of **decubital ulcers**. Taddei (*Polinclinico*, Jan. 19, 1913).

In **brain lesions** resulting in loss of power in one or more extremities, strychnine may be employed to maintain the nutrition of the paralyzed limbs. In **hemiplegia**, when nerve degeneration has not yet set in and the paralyzed muscles are not completely relaxed, strychnine is an efficient remedy. It is of no avail, however, when electric contractility has been lost, or, in very recent cases, in which it may do distinct harm. Any tendency to spasticity in nervous affections contraindicates strychnine.

Hypodermic use of strychnine sulphate has a good local effect and is of temporary benefit in cases with paralyzed muscles. Some patients require five to ten times the usual dose: $\frac{1}{4}$ grain (0.016 Gm.) is about the proper amount where paralysis is complete.

In a case of **acute transverse myelitis**, with paralysis of one leg from the hip down, $\frac{1}{20}$ grain (0.003 Gm.) and later $\frac{1}{10}$ grain (0.006 Gm.) of strychnine sulphate was injected in the paralyzed muscles daily for many days, with the result that the patient was enabled to walk.

A second case was one of apoplexy followed by **hemiplegia** of the left side. Fourteen days after the stroke

commenced, hypodermic injections of strychnine sulphate were given, using $\frac{1}{20}$ grain (0.003 Gm.) tablets twice a day, and running the dose up to $\frac{1}{10}$ grain (0.006 Gm.) on the third day, and finally to four tablets twice a day, or $\frac{1}{20}$ grain (0.026 Gm.) per day, which treatment was continued for eight days. The patient gained rapidly in every way, and eight weeks after the attack was walking with a cane, though he could not move the fingers. W. G. Steele (*N. Y. State Jour. of Med.*, Oct., 1908).

In **incontinence of urine or feces**, due to lowered activity of the lumbar spinal centers governing the sphincter muscles, strychnine is at times of considerable value. The **nocturnal enuresis** of children, when not relieved by belladonna, ergot, and iron, may be benefited by nux vomica.

In **diabetes insipidus**, strychnine has at times been found of value. As a stimulant to the sexual center in the spinal cord, strychnine may be used in cases of **impotence** not due to pronounced organic lesions.

In **amblyopia due to tobacco, alcohol, lead, arsenic**, and other drugs, as well as in some forms of **optic neuritis**, strychnine given hypodermically in ascending doses is of some value in preventing blindness or accelerating recovery. Beginning with $\frac{1}{40}$ grain (0.0015 Gm.) the dose may be gradually increased to $\frac{1}{8}$ or $\frac{1}{6}$ grain (0.008 or 0.01 Gm.). De Schweinitz in these cases advises ascending doses of the tincture of nux vomica, beginning with 3 drops three times daily until physiological effects are apparent; in some instances 60 drops in the twenty-four hours may be reached.

Where there is weakness of the extraocular muscles, with or without actual **strabismus**, and with **eye-strain**

dependent thereupon, nux vomica or strychnine does much good by improving the tone of the nerve-centers from which these muscles are innervated. Sometimes in **incipient cataract** strychnine will slow the development of the opacity in the crystalline lens.

Strychnine has at times proven efficient in various forms of **neuralgia**, especially those affecting the viscera (**gastralgia**, **hepatalgia**, etc.), and also in **infraorbital neuralgia**. The **neuralgic** form of **dysmenorrhea** is sometimes relieved by the administration

of nux vomica during the intermenstrual intervals. In **amenorrhea** the tonic action of nux vomica on the pelvic viscera not infrequently affords an indication for the use of this remedy. Barker's formula for **post-partum hemorrhage** is: Tincture of nux vomica, 20 drops; fluidextract of ergot, 30 drops; to be given, and repeated if necessary, until the uterus is well contracted.

C. E. DE M. SAJOUS
AND
L. T. DE M. SAJOUS,
Philadelphia.

O

OBESITY.—DEFINITION.—

An abnormal accumulation of fat in the subcutaneous and other tissues, due to deficient oxidation of fats formed from ingested starches and fats and also, though less actively, from ingested proteins.

SYMPTOMS AND PATHOGENESIS.—The problem has assumed various new aspects in recent years owing to the addition, to our working field, of organs—the ductless glands—which were formerly disregarded. Some of these structures are concerned with general metabolism to such a degree that to study obesity without taking them into account entails the danger of grave diagnostic errors.

In the light of modern research, obesity should be divided into several forms each of which will be reviewed separately, insofar as symptomatology and pathogenesis are concerned.

Common Obesity (Lipomatosis Universalis).—In this, the most wide-

spread form of obesity, a diffuse, relatively even distribution of the fatty deposit throughout the various parts of the body is generally a striking feature. The severity of the condition, however, varies within wide limits. To the simple fatty accumulation commonly observed in men of advancing years, with increased abdominal circumference as the chief manifestation, the term obesity, or lipomatosis, is scarcely applicable in its strict sense, for true obesity is an abnormal state and the condition of the group of stout individuals referred to cannot be definitely stated to be abnormal. At the opposite extreme stand those cases of general fatty accumulation so marked as to be a constant source of comment on the part of passers-by and of danger to the individual himself through overburdening of the heart, with the possibility of sudden failure of its function.

The most superficial and obvious

division of cases of common obesity is that based upon the apparent general condition of health of the individual. In popular terms the distinction is thus made between "good fat" and "bad fat," the first designating the type of obesity in which the subject is vigorous and of florid, healthy appearance, while the second relates to patients with an anemic, rundown aspect, in whom the obesity has given rise itself to, or become otherwise associated with, complications implying injury to visceral organs or deviations from the normal processes of tissue consumption and repair. In the "healthy" *florid type* of obesity the increase in weight is due merely to the actual deposits of fat in the body, and the circulation is as yet but slightly or not at all impaired. The "unhealthy" or complicated type is the natural sequel of the previous form if it be sufficiently marked and persistent; not only is the patient pale, weak, and cachectic,—the so-called *anemic type*,—but there is commonly an excess of water in the tissues in addition to the fat.

Another group of cases of obesity, termed *alimentary obesity*, is that based upon the amounts of food and of outdoor physical exercise taken. Where the quantity of food ingested is unusually large, or is merely large in comparison with the amount of physical work performed, a condition arises in which the income of absorbed food material is considerably greater than the amount used up in setting free the energy required in muscular activity, and excessive storage, not only of fats, but also in some degree of carbohydrates, takes place. The condition resulting in such cases is termed *alimentary obesity*. In other cases,

on the other hand, where the increase in body weight has not been due to overnutrition, but has occurred for some other reason, and shows a tendency to persist in spite of a reduction of the food intake below normal and an increase in the amount of physical exercise taken, the condition is designated *constitutional obesity*.

The writers recognize the existence of a constitutional obesity in which there is no interdependence between food intake, energy expense and weight. Underweight in otherwise healthy persons also occurs even when the caloric intake is more than sufficient to supply energy demands. The data collected by the authors in their investigations tend to prove that certain types of obese persons maintain their weight without regard to the usually accepted caloric balance. Strouse and Dye (*Arch. of Int. Med.*, Sept., 1924).

While the deposition of fat in common obesity may give rise to no symptoms other than obvious enlargement of the body, or inconvenience in locomotion, etc., there appear, when the obesity reaches certain limits, evidences of interference with the functions of various organs: In particular, dyspnea, especially on exertion, due to embarrassed cardiac action, (fatty degeneration or fatty overgrowth, *q.v.*, in the fifth volume,—see Index) and its complications, passive pulmonary congestion, cyanosis, edema, etc.

The digestion is often impaired, the liver enlarged, and constipation is common. Both diabetes and gout are not infrequently observed in the obese, who also show a predilection to infection owing to their low resistance to bacterial development. In obese females, sterility and amenorrhea are commonly noted.

An obesity of 100 kg. (224 lbs.) or more is usually accompanied by some pathologic condition, usually asystole and uremia, diabetes, gout and lithiasis. But 4 out of 43 cases showed simple plethora. The blood pressure and viscosity were almost invariably above normal. The parallelism was striking between the weight, pressure and pulse in 3 cases. Treatment must be individualized accordingly. Martinet (*Presse méd.*, Jan. 22, 1921).

Adiposis Tuberosa Simplex.—This form of obesity, first described by James M. Anders, of Philadelphia, is characterized by the formation of circumscribed fat masses in the subcutaneous tissues. These masses are moderately dense, slightly movable, somewhat flat, and range in size from a bean to that of a hen's egg. They vary from a dozen to two dozen or more, are confined to the extremities, especially the lower, in some; in others occur on the abdomen. They are sensitive to the touch and may be the seat of pain. The mammae and abdominal panniculus adiposis may overhang. It is uncommon, Anders having observed it in only 4 out of 324 cases of obesity.

Adiposis Dolorosa.—This disease, first described by Dercum, of Philadelphia, consists in the irregular deposition of masses of fat in the subcutaneous tissues. These masses are painful to the touch and the seat of spontaneous pain. Dercum's disease has been described in full in the first volume (see ADIPOSIS DOLOROSA).

The Obesity of Hypothyroidism.—The close connection between the thyroid and general metabolism has been reviewed under "Thyroid" in the article on ANIMAL EXTRACTS in the first volume. Briefly, its influence on the growth and metabolism and of

the functional activities is well illustrated by the remedial use of thyroid gland in cretinism. In myxedema a more or less rapid loss of weight is noted. A number of investigators have found that this was accompanied by an increase of the nitrogen excreted with the urine. While the oxygen intake was greatly increased—almost doubled at times—the carbon dioxide excretion was greatly increased. Normal individuals have likewise been found to utilize more oxygen and excrete more carbon dioxide under the influence of thyroid medication. All these biological phenomena return to normal as soon as its use ceases. The body fats have been found to be first used up, then the proteins, until then spared to a marked degree, are attacked.

How does thyroid produce these effects? This point has not been finally determined. The only theory before us at the present time is my own, advanced in 1907, viz., that the thyroid sensitizes the nucleins of the tissue-cells, including those of the nuclei of fat-cells, to oxidation, the process corresponding with that through which Wright's opsonins render bacteria vulnerable to the phagocytes.

From my viewpoint, then, it is not by a direct action on the tissues that the thyroid secretion or therapeutic agents produce their effects, but by urging them, as catalyzer probably, to be oxidized more easily. It renders the nuclear phosphorus more inflammable as it were. This accounts not only for the increased intake of oxygen referred to above, but also for the large increase in the phosphoric acid excreted recorded by Chittenden and others.

Case of endogenous obesity with lowered basal metabolism in which loss of weight occurred under thyroid gland together with a low caloric diet. Absence of weight loss after lowered food intake and sufficient exercise suggests a rational basis for the giving of thyroid. The latter should, however, be employed under proper control, including estimation of the heat production of the body. Of 33 cases of obesity, 28 were classified as simple and 5 as of pituitary origin. A basal metabolic rate within normal range was found in 23 of a series of cases, as against 9 with an increase exceeding 10 per cent., and 9 with a decrease exceeding 10 per cent. In 4 of the 9 with subnormal basal metabolism, evidences of endocrin disease were observed. C. A. McKinlay (Minn. Med., June, 1925).

Thyroid obesity, then, is that form in which the organ fails more or less to sensitize adequately the tissue nucleins. Hydrocarbons thus accumulate in various regions in the form of fat. These cases can easily be detected, as a rule; besides their obesity, they present more or less marked stigmata of hypothyroidism—often confused with the anemic type of case.

The relationship of the thyroid to obesity seems more soundly established than is the case with any other endocrin organ. The slowed metabolism of hypothyroid subjects does not, however, invariably involve the production of obesity, since there are some cases of larval myxedema which, retaining some activity in life, are not obese. For obesity to occur, overeating must exist in addition; furthermore, the reduced mental and physical activity which appertains to myxedema constitutes an auxiliary cause of obesity.

Lowering of the respiratory interchanges was observed in only 28 per cent. of the writer's obese patients. M. Labbé (Rev. de pathol. comp., Jan. 5, 1925).

The Obesity of Hyperadrenalism.—

The adrenals produce obesity in precisely the opposite way. Although I believe that these organs are instrumental to a material degree in producing the form commonly observed in plethoric subjects and due to the excessive ingestion of food, owing to the abnormal activity to which they are continuously subjected, those cases will only be considered here in which an absolute connection is known to exist between the adrenals and lipomatosis. Thus, while we know that destruction of the adrenals brings on Addison's disease, in which asthenia and decreased nutrition are the preponderating phenomena, we have precisely the opposite condition in malignant hypernephroma of the adrenals, in which there is exuberance of adrenal tissue. Here, besides the obesity, which attains in some instances museum-freak proportions, there is every evidence of exaggerated metabolism. Children suffering from this disease may become twice or three times taller than is normal at the corresponding age. There is abundant growth of hair, and the genitalia may be as fully developed as those of an adult, though the child be perhaps but 6 or 7 years old.

How explain this form of obesity with the prevailing conception of the functions of the adrenals as the only foundation? Textbooks of physiology teach that the adrenal secretion raises the blood-pressure and increases the power of cardiac contractions, while slowing the heart; and, moreover, that it governs the sugar content of the blood, thus influencing carbohydrate metabolism. That these functions, though well grounded, fail to explain the morbid process described,

particularly the marked overgrowth and lipomatosis, is obvious.

All tissue, bones, muscles, nerves, etc., undergo excessive development; and, inasmuch as the adrenal secretion or extractives raise the temperature, increase the oxygen intake, the carbon-dioxide output, and awaken other phenomena which are always taken as evidences of increased oxidation, we cannot escape the conclusion that the adrenals are deeply concerned with general metabolism. In 1903 I advanced the view that the adrenal secretion took up the oxygen of the air in the lungs, and then became that part of the hemoglobin molecule which served to sustain tissue oxidation. This being accepted, the connection of a great excess of adrenal secretion such as is produced in hypernephroma and the obesity produced become intelligible. We are dealing with an *exaggerated upbuilding process*. The appetite and thirst are excessive in these cases, and the entire organism is developed two, three, and even four times as rapidly as it should be, judging from reported cases.

[A distinction must be clearly apprehended in this connection between the influence of the adrenals on adiposity and that of the thyroid on the same process. While the adrenals produce it through exaggerated functional activity, the thyroid brings it about through diminished functional activity. The former is an active upbuilding process, while the latter is a passive accumulation of substances which would be adequately used up were the thyroid functionally efficient. The importance of this fact asserts itself when the treatment of these cases is in order. It is obvious that while thyroid gland would prove useful in a case of obesity due to hypothyroidia, the same treatment, by activating metabolism in a case of hypernephroma or its benign homologue, ple-

thoric obesity, would prove harmful by enhancing metabolism. C. E. DE M. S.]

The Obesity of Castration.—As specified elsewhere, I do not believe that the organs which produce an internal secretion are as numerous as is generally believed; the thyroid and the adrenals are true internal secretion glands, from my viewpoint, however, in the sense that their hormones are of use as such throughout the body at large. In this class I do not include the ovaries or testes, but regard these organs as the source of what I have termed an "autonomous secretion" which means that it is intended only to influence those structures or organs which form part of the mechanism to which the secreting gland belongs, the genital mechanism in the present instance.

This view would not seem to account for the familiar phenomena that follow castration or oöphorectomy, but it does so better than the prevailing doctrine, which offers no explanation. From my viewpoint, the testicles and ovaries *partly* build up their autonomous secretion from adrenal and possibly other as yet unknown substances; they then utilize what portion of this synthetic secretion is needed for the specific function of the sexual apparatus, with which their secretion is concerned: menstruation, semen formation, and pregnancy, for instance, then return the *unused surplus* to the organism at large. As stated, these organs are only supplied partly from the system at large; there is much chemical and pharmacological evidence to show that besides building up nucleins,—those constituting the heads of spermatozoa, for example,—some of their tissues belong to the chromaffin sys-

tem, and that they are thus able to create themselves a true adrenal secretion to contribute to and enhance when need be,—as during the uterine development of pregnancy, for example,—local metabolism. Accordingly, what they contribute to the organism at large is not wholly unused material borrowed from it, but also substances which, though similar to those found throughout the whole organism, are part of the general asset in those substances.

The effects of oöphorectomy or castration now suggest themselves. We have seen that—from my viewpoint—the thyroid and adrenal secretions and the nucleins are active participants in general metabolism. Removal of the testes or ovaries thus means deprivation on the part of the general organism of a portion of the substances necessary to its cellular exchanges, which means the vital process itself. In the young these operations inhibit the development of what remains of the genital organs, and prevents the growth of hair; in adults, the remaining genital structures atrophy and more or less obesity results.

The obesity following castration or oöphorectomy thus finds its explanation in a general slowing of the tissue interchanges, owing to deficient oxidation, through loss of what adrenal secretion and nucleins the removed organs would have contributed to the body at large under normal conditions.

Obesity Due to Lesions of the Pituitary.—The foregoing statements have prepared the way for an analysis of the forms of obesity due to lesions of the pituitary body. The word "forms" is employed in this connec-

tion because, interpreted from my viewpoint, both the Fröhlich syndrome—the more important of the clinical symptom-groups of this class—and Dercum's adiposis dolorosa are due to lesions of this organ—though these lesions are quite dissimilar insofar as their location in the organ itself or the peripheral tissues are concerned. To convey clearly the manner in which obesity is produced, a brief survey of my interpretation of the functions of the pituitary is necessary.

I held, over a decade ago, that the pituitary was not, as is generally believed, a secreting gland. It is composed of two parts: (1) a glandular or spongy portion composing the anterior lobe, and (2) a nervous portion, the posterior lobe, which includes a layer, the *pars intermedia*, that separates it from, but is in juxtaposition with, the anterior lobe. It is this *pars intermedia* which is said to produce the secretion that extracts of the posterior lobe, or the active material obtained from it, are supposed to represent. Now, the weakness of the view that the pituitary is a secreting gland is shown by the fact that the only glandular portion of the organ, the anterior lobe, the structure of which alone suggests such a function, produces extracts which are inert, as first shown by Howell, while the structure which produces active extracts is a nervous organ presenting no secretory characteristics and connected directly with the brain. The colloid masses supposed by Thaon, Herring, Cushing, and others to be secretory products are present in the inert anterior lobe, but not in the active posterior lobe, according to Grünbaum. Indeed, there is ground

for the belief, to which Halsted has added especial testimony, that the colloid found in large quantities in relatively inactive thyroids is an inert substance and not a secretion at all, its presence in the inert anterior lobe being additional proof of this fact.

It is thus apparent that the anterior lobe of the pituitary has none of the pharmacological attributes of a secreting organ.

[Though resembling histologically a gland, the posterior lobe to which the pars intermedia belongs has no claim whatsoever to be regarded as such. Indeed, as stated by Swale Vincent in reference to this lobe, "it is extremely difficult to imagine how such a structure can be regarded as a secreting gland." Finally, were the pituitary body the source of an internal secretion necessary to the well-being of the organism at large, a true hormone, the organ could not be removed, when diseased, as it has been in numerous instances by Hochenegg, von Eiselsberg, Cushing and others, without, as is the case with *bona fide* ductless glands, the thyroid and adrenals for instance, compromising life. That this does not follow the operation—even though death follow the removal of a normal pituitary—is readily explained if, with me, the organ is regarded only as a co-ordinating center with subsidiary centers, including probably the pineal, in the cerebrospinal axis, that are capable of taking up, *even though imperfectly*, its functions as chief center when it becomes diseased.

As to the functions which the pituitary co-ordinates, I will merely, in the present connection, recall that I have long held that this organ governed, by way of the spinal axis, as stated above, the functions of the sympathetic system, and through this system and among other organs, the thyroid and adrenals. This view has been combated, but by no means with convincing facts, and the day is not far off when its strength will surely assert itself. C. E. DE M. S.]

Granting, then, that the pituitary body governs the functions of the

thyroid and adrenals, we gain an insight into the, at present obscure, pathogenesis of the two conditions in which obesity is a prominent feature, Fröhlich's syndrome.

Fröhlich's dystrophia adiposogenitalis, in the light of the foregoing facts, becomes the symptom-complex of deficient activity of both the thyroid and adrenals as a result of destructive or inhibitive disease of the pituitary body or of its efferent channels. Besides the symptoms, headache, hemianopsia, etc., which in progressive cases are due to pressure by the diseased pituitary body, etc., the phenomena denoting thyroid insufficiency are often very clearly defined. Thus, besides the obesity, which may be very marked, the tissues may become myxedematous, hard and tense to the touch; infantilism is a prominent feature in most young subjects and the rheumatoid pains of hypothyroidism are not infrequent. The menstruation is irregular or inhibited, though metrorrhagia is sometimes witnessed. The intelligence is dulled and mental disturbances are frequently noted. The patients are potbellied and moon-faced. In a case personally observed in the course of a lawsuit, several physicians had given a diagnosis of myxedema under oath, so marked were the phenomena of hypothyroidism.

The symptoms of insufficiency of the adrenals are no less prominent. We have seen that excessive activity of these organs gives rise to premature development of the genital organs and excessive growth of hair. In the deficiency of adrenal activity which from my viewpoint occurs in Fröhlich's disease, we have opposite conditions: the genital organs remain

infantile while there is absence of hair in the pudendal and axillary regions. Cases developed after puberty show hypothermia and progressive loss of hair and of sexual characteristics, besides the symptoms of hypothyroidia enumerated.

[The laboratory has confirmed the teachings of the clinic. Crowe, Cushing and Homans found that the animals which recovered after removal of the pituitary, showed disturbances similar to those noted in man; they became obese, sexually impotent, mentally abnormal, and showed evidences of disturbed cutaneous nutrition, atrophy of the genital organs, disordered carbohydrate metabolism, and a lowered temperature—all phenomena markedly influenced, we have seen, by the adrenals.

A feature upon which I wish to lay some stress in this connection is, that while fully developed cases of Fröhlich's adiposogenital syndromes are relatively rare, many of the fat, moon-faced and large-limbed children commonly observed are examples of a larval type of the disease which, though not progressive, as are the cases due to malignant growths of the pituitary or of its surrounding structures, may nevertheless permanently impair the child's mentality and sexual attributes. Such cases are usually due to lesions of the pituitary produced in the course of some infection, a part of the organ becoming sclerotic. Several microphotographs in my work on the Internal Secretions illustrate such lesions as produced by alcohol, ricin, etc. Such children, though stout, are apt to be pale, anemic and mentally backward, the genital organs and their hairy covering developing late. Identified in time, such children are greatly benefited by treatment. C. E. DE M. S.]

Another feature which merits emphasis is that, in the light of my views, *i.e.*, with deficient thyroid and adrenal activity as the foundation of Fröhlich's syndrome, the lesion need not be located in the pituitary itself, as already mentioned, but anywhere along the path of the fibers it sends

via its infundibulum, the basal tissues, the bulb, etc., and the sympathetic or autonomic system to the thyroid and adrenals. They explain why tumors located almost anywhere in the base of the brain may cause the disease.

Aberrant types of Fröhlich's syndrome, including its obesity, are frequent; but if we recall that the presence of a tumor in the pituitary may excite it to inordinate activity at first, the presence of acromegaly, for instance, with symptoms of hyperthyroidism and hyperadrenism in some cases, followed ultimately, as a result of advanced lesions, by hypothyroidism and hypoadrenism, *i.e.*, the typical Fröhlich syndrome.

ETIOLOGY.—The statistics of Bouchard, Kisch, Chambers, and Oulmont and Ramond averaged, tend to show that 52 per cent. of obese individuals are the offspring of obese parents. J. M. Anders places it as high as 60.7 per cent., with several generations, as the basis of his inquiry. To this predisposing cause may be added the gouty or arthritic diathesis, so-called, and the manifestations of the latter, asthma, lithiasis, eczema, migraine, etc., all conditions in which oxidation is slowed. While the inherited type tends to develop in the young, there is a general tendency toward adiposity after about the thirty-fifth year in women and after the fortieth in men. Females, owing mainly to greater indolence, the puerperium and the menopause, are predisposed to obesity to a much greater degree than males.

Persistent obesity in children should be looked upon with suspicion, lest an infectious disease, by causing lesions of one or more of the ductless

glands, have brought on one of the special types attributed to these organs and described under the preceding heading.

Excessive alimentation in a normal subject tends to produce obesity when the diet is mainly composed of carbohydrates: bread, potatoes, sugars, etc., and fats, although albuminoids are also fat-producing foods, though to a lesser degree.

The experiments of Genth and Robin, and particularly the investigations of Hawk, have demonstrated that an excess of water during meals increases nitrogen excretion and, in fact, that of all urinary salts. This was obviously due to a washing out of the tissues, as it were, since the increase of excretory products was only temporary. If the kidneys are the seat of some disorder which inhibits their function, fictitious obesity may occur through accumulation of water in the tissues along with the chlorides.

Alcohol differs in its effects according to the manner in which it is used. Concentrated, as it is in whisky, brandy, etc., it tends more to cause emaciation than obesity, owing to the fact that it then promotes oxidation by stimulation. If indulged in to excess it gives rise to lesions in various organs, particularly the liver, and in this way produces emaciation.

Atwater holds that alcohol spares fats by being oxidized in lieu of the latter, but Leven found that when alcohol was replaced by another agent as readily oxidized as alcohol fats were not spared.

Diluted alcohol such as beers, wines, etc., do not interfere with assimilation, and may, in fact, enhance it, unless taken in excessive quantities. Obesity is thus favored.

In women particularly castration is an important cause of obesity owing to the premature menopause induced. This does not always apply as regards the male sex, many eunuchs being tall and thin, a fact also illustrated by spayed horses. Indolence in such, however, will be followed by obesity, the tendency being toward slowed tissue oxidation and catabolism. Lactation also tends to favor the development of obesity.

Obesity may follow typhoid fever, pneumonia, pleurisy, measles, and pertussis, or occur in subjects exposed, in the course of their daily occupations, to poisoning by lead, phosphorus, or arsenic. Very minute doses of these toxics and also of morphine, strychnine, tubercle toxins, and diphtheria toxins given to guinea-pigs along with their food, cause these animals to increase in weight, sometimes very markedly and rapidly.

Cases traceable to persistent though slight hemorrhages, as in recurrent epistaxis and metrorrhagia, are not infrequent. Cattlemen in some parts of Europe subject cattle to occasional bleedings to increase their market weight. Vulpian and Dechambre have observed the same effect experimentally in dogs. Anemia and chlorosis are familiar causes of obesity, doubtless due in such cases to the deficient oxidation incident upon the loss of hemoglobin.

A sedentary life predisposes to corpulency owing to the slowed oxidation resulting from deficient muscular activity. Rest-loving and phlegmatic individuals, and the inhabitants of tropical countries in which the climate almost imposes indolence are often obese.

Emotions and traumatisms have

also been found to precede the development of corpulency. In such cases there is usually a predisposition to the disorder through heredity or some constitutional disorders, as gout, in which tissue metabolism is slowed.

PATHOLOGY.—In the average adequately nourished individual fat accounts for about one-twentieth of the total body weight. In the female the proportion is even somewhat larger. The amount may be considerably larger, however, without being an indication of impaired health, fat constituting as much as one-thirteenth of the body weight in not a few instances. Thus, in an individual weighing 160 pounds, 8 to 12 pounds of this weight will consist of fat.

The fat is not, as might be supposed, deposited exclusively beneath the skin, but occurs also in appreciable amounts in numerous less superficial localities, notably in the omental appendages in the abdominal cavity, the mesentery, or sling by which the intestines are suspended from the posterior wall of the abdomen, the marrow of bones, the spaces behind the eyeballs in the bony orbits, the tissues surrounding the kidneys, the layer of tissue beneath the pericardium, as well as some tissues in the neighborhood of joints. In but few localities, *e.g.*, in the lungs, in the interior of the skull, and in the tissues immediately beneath the skin where the latter is very thin, as in eyelids and certain portions of the external genitals, is fat constantly absent.

The tissue in which fat is chiefly deposited, commonly termed "adipose tissue," is in reality a modified form of connective or supporting tissue, the cells constituting the latter, pre-

viously flattened or spindle shaped, becoming gradually distended with clear, oily fat, and being then termed "fat-cells." Fat-cells in their earlier stages of development thus present the aspect of a signet ring, the nucleus of the original connective-tissue cell forming a rounded knob on one side, while the protoplasm or remaining material of the cell forms a narrow even band around the accumulating mass of fat. In the adult fat-cell, on the other hand, the protoplasmic ring has become so thin as to be frequently invisible, except in the vicinity of the now more or less flattened nucleus, the cell as a whole appearing essentially as a large, clear globule sharply marked off by the limiting cell membrane. Well-distended fat-cells measure about 0.02 mm. ($\frac{1}{1250}$ inch) in diameter, *i.e.*, are about three times as large across as the ordinary red blood-cell. The fat-cells are for the most part in immediate mutual contact, but are disposed in groups separated by layers of unmodified connective-tissue cells, which tend to support and impart firmness to the fatty accumulation as a whole. Where fat exists in considerable masses the individual cells assume a polyhedral rather than spherical form, owing to mutual pressure, and the groups of cells appear to the naked eye, when the fatty tissue is cut into, as yellowish, granular bodies. In the connective tissue separating the lobular aggregations of fat-cells run the numerous fine blood-vessels required as avenues of nutritive supply to and outlet from the fatty deposits. Where, by reason of starvation, the fat-cells are relieved of their reserves of fat, they are in most instances capable of returning to their original condition

as ordinary connective-tissue cells. In certain aggregations of cells, however, the so-called "fat organs" of Toldt, this property is in abeyance, the cells being more strictly fat preservers than the common variety, and yielding their contents only under circumstances of the utmost necessity.

In a study of 1000 cases recorded in life insurance tables, the writer noted that the *blood-pressure* was usually high, and that it fell with decreasing weight. Of the 1000 cases studied, 432 gave evidence of organic heart trouble and 230 of functional disease; 463 gave evidence of renal impairment; 53 cases out of 700 showed sugar in the urine. The basal metabolism was, however, found within normal limits. As to the *mortality*, studies based on more than 250,000 overweight people showed that up to 10 pounds there is no increase in mortality, but above that figure the mortality rises steadily. There is, however, no marked increase in mortality up to the age of 25, even in the very obese. At 25 years the mortality rises from 15 pounds overweight and upwards, and at and beyond the age of 40 the rise in rate is rapid, increasing with the rise in the overweight. W. E. Preble (Boston Med. and Surg. Jour., Apr. 26, 1923).

Obesity is associated with a disturbance of glucose regulation, as shown by carbohydrate tolerance tests. In some obese persons, ingestion of carbohydrate merely induces a more marked and lasting rise of blood sugar than it does in normal subjects, but in others, taking 50 Gm. of glucose gives rise to a paradiabetic condition, *viz.*, hyperglycemia together with glycosuria. In contradistinction to diabetes, however, the disturbance of glucose regulation attending obesity can generally be quickly cured. M. Labbé and R. Boulin (Presse méd., Aug. 26, 1925).

TREATMENT.—The cause should, of course, be carefully ascertained,

and treatment regulated accordingly. The medicinal treatment of obesity, other than **organic products** in carefully selected cases, is practically useless. Main dependence, in fact, should be placed upon **diet** and **exercise**.

Experience shows that usually children with early inherited obesity develop diabetes before 40. This occurs in only about 50 per cent. when the inherited obesity does not develop till late, and in only 15 per cent. when the obesity is acquired. After puberty, if the obesity declines, the outlook is favorable, at least to 35 or 40. But if the endocrin glands show insufficiency, progressive dystrophy may be anticipated. Obesity in the parents should be combated; especially during pregnancy the diet should be supervised. Organotherapy is indicated in certain cases. Thus, a girl at puberty threatened with the adiposogenital syndrome may be given **thyroid**, **ovarian** and **pituitary gland** in turn for 10 days each, or the 3 may be combined. Or, **potassium iodide** might be given for 10 days each month (0.1 or 0.2 Gm.—1½ to 3 grains—daily). G. Mouriquand (Lyon méd., Nov. 10, 1920).

Diet.—A principle which will be found to apply to most cases of obesity, *viz.*, those in which some disturbance of the ductless glands or other organic disorder does not exist, is briefly as follows: An obese subject who maintains approximately a normal balance as to weight on a normal diet can stand a certain reduction in his fare, but if this limit is exceeded cardiac complications will appear. The limit, which varies in each case, cannot, therefore, be gauged by calories. The heart must be watched, lest tachycardia occur, and treatment should be begun by reducing by one-half the fats and starches, especially flour, potatoes, and beans, usually taken.

In obese children, the writer advocates **measured feeding**, with reduction of calories by $\frac{1}{3}$ the preexisting daily average, and later further reductions of 100 calories to as low as 800 or 900 a day, if necessary. The **diet** is to consist of lean meats, fruits, vegetables, salads with little oil, bran muffins, and bulky foods which will satisfy the appetite while preventing constipation. W. R. P. Emerson (Boston Med. and Surg. Jour., Oct. 20, 1921).

Following **diet** recommended: *Break-fast*, 7.30 A.M.—Cold lean meat, 2 to 4 ounces (60 to 120 Gm.); 2 drams (8 Gm.) of bread; a cup of weak tea, without sugar or milk. *10 o'clock*.—1 egg, without bread. *12 o'clock*.—Roast or grilled meat, 2 to 4 ounces (60 to 120 Gm.), without gravy or sauce; green vegetables *ad lib.* without butter or grease; weak tea, without sugar. *4 o'clock*.—A cup of tea, without sugar. *7 o'clock*.—2 eggs, green vegetables, 1 ounce of bread, weak tea. A walk is taken after each of the principal meals. The patient will lose 20 to 24 lbs. in 25 days. The rigor of the régime may then be lessened, the quantity of bread increased, and a little butter allowed in the vegetables. After some months on this régime, the patients will have lost from 40 to 50 pounds in weight, whereupon the dyspeptic troubles, oppression and bronchial catarrh from which they generally suffer will have practically, if not entirely, disappeared. Haticgan (Vienna Letter, Boston Med. and Surg. Jour., Dec. 18, 1924).

If the patient fails to lose weight in two weeks, then **butter, milk, fats** in general, should be **forbidden** and **exercise** over and above that usually taken ordered. If he habitually walks about one mile, he should gradually increase the distance—which should be established by the attending physician—until five miles are walked briskly each day. These simple measures are often sufficient, if persisted in, to afford good results.

An important indication is to promote oxidation through **exercise**. In well-marked cases, however, little exercise should be taken until some fat has been removed, to avoid overtaxing the heart. Walking or horseback riding in the open, preferably directly after the morning and noon meals, are useful. Golfers and tennis players should pursue their favorite games systematically. Besides promoting destruction of fat, exercise invigorates cardiac action. Where the circulation is beginning to fail or is decidedly impeded, the exercises should be carefully graduated. Some of these cases do very well under **Oertel's plan**, *viz.*, specifying a short distance at the outset, to be undertaken daily, then gradually increased. That part of the Oertel method having reference to the degree of inclination, however, cannot always be successfully carried out at home. In the small percentage of cases in which cardiac dilatation is present, with or without murmurs, the **Schott "resistance exercises"** may be carried out with excellent effect. When oxidation cannot be sufficiently promoted by exercise, **deep massage** is the best known supplementary agency.

In plethoric obesity carbohydrates and fats should be considerably restricted—to about $\frac{1}{2}$ the amount previously taken. As for proteins, efficiency is best maintained by about 120 Gm. daily at moderate work. Bread, cream, and sweets should be used sparingly, and potatoes, fruits, and green vegetables taken instead. Fat, 45 Gm., and carbohydrates, 140 Gm., are useful in many cases. Little fluid at meals should be allowed, but not less than 8 ounces (240 c.c.) on rising and 3 hours after meals. In extreme obesity, the patient should be put to bed for 2 weeks and his caloric intake carefully regulated and weighed. J. M. Anders (Atlantic Med. Jour., May, 1924).

Reduction of the quantity of food ingested to normal limits is, of course, indicated in individuals who eat excessively, either at the regular meals

or by eating between meals or the now fashionable "midnight supper." Careful mastication is of major importance.

In some patients the evening meal is the harmful one, owing to the slowed oxidation incident upon rest and sleep which follows it. A very light meal, or one or two cups of tea with a couple of slices of bread and butter, without other changes in the dietary or habits suffice in some cases to cause a gradual reduction in weight.

Von Noorden advocates small but frequently repeated meals, the aim being probably to insure perfect digestion of all foods, while avoiding those which promote the accumulation of fat. He orders the following diet: At 8 o'clock 80 Gm. (2¾ ounces) of lean cold meat, 25 Gm. (6¼ drams) of bread, 1 cup of tea, with milk and no sugar. At 10 o'clock 1 egg. At 12 o'clock 1 cup of strong broth. At 1 o'clock a small plate of meat-soup, 159 Gm. (5½ ounces) of lean meat, flesh or fish; 100 Gm. (3½ ounces) of potatoes with salad; 100 Gm. (3½ ounces) of fresh fruit. At 3 o'clock 1 cup of black coffee. At 4 o'clock 200 Gm. (6¼ ounces) of fresh fruit. At 6 o'clock ¼ liter (½ pint) of milk with tea. At 8 o'clock 125 Gm. (4 ounces) of cold meat or 180 Gm. (6 ounces) of meat, raw and grilled, and eaten with radishes and salads; 30 Gm. (1 ounce) of graham bread, and 2 or 3 teaspoonfuls of cooked fruit with sugar.

The writer found that to disregard the calories and provide foods which were readily digested enabled him to obtain better results. An antidyseptic diet, by insuring perfect digestion and thus avoiding irritation of the

sympathetic system and through it the ductless glands prevents the nutritional disorders provoked by the latter. Pron (Paris médical, April 26, 1913).

The dietary recommended by **von Noorden** can only be carried by persons who have no occupation. In such and with appropriate exercise it is said to be effective. In individuals who are occupied, however, the following measures are sometimes efficient. The total quantity of food ingested and the fats and starches are diminished, but the albuminoids are taken as usual. The diet is as follows: *Breakfast*: One cup of coffee with milk; bread, 2½ ounces (75 Gm.). *Luncheon*, noon: One plate of soup, 5 ounces (150 c.c.); lean meat or fish, 2 green vegetables, lettuce; bread, 1 ounce (30 Gm.); pudding or fruit, water as beverage. *Supper*: Two eggs or meat, 3 to 4 ounces (90 to 120 Gm.); bread, 1 ounce (30 Gm.); salad; fruit; tea, 1 or 2 cups; water.

This diet is to be kept up for months, the patient being weighed every other week. When the desired weight is reached the food intake is gradually increased, beginning with the albuminous foods, but as soon as a slight increase in weight appears the diet should be slightly reduced and maintained at that point, which will represent the patient's assimilation level.

Anders recommends the following dietary, subject to slight modifications to suit individual cases: *Breakfast*: Fruit, as an orange or 2 peaches or half a grapefruit (without sugar) or a sour apple; fine wheat bread, 1¼ ounces (0.4 Gm.); a soft-boiled egg; milk, 1 ounce (30 c.c.); saccharin, ½ grain (0.03 Gm.); coffee, 4¼ ounces (127 c.c.). *Luncheon*: Caviar, 2

drams (8 Gm.); lamb chops, sweet-bread, boiled ham (cold), or fowl or game in season, 3 to 4 ounces (90 to 120 Gm.); salad, 1 ounce (30 Gm.) (with a small amount of French dressing); cheese, 1 dram (4 Gm.); bread, rye or bran, $\frac{1}{2}$ ounce (15 Gm.); fruit (except strawberries and bananas), or (instead of the latter) water, 4 ounces (120 c.c.). *Dinner:* Soup (clear), 3 ounces (90 c.c.); fish, 2 ounces (60 Gm.); roast or broiled beef, lamb, veal, or game or poultry, 4 to 5 ounces (120 to 150 Gm.); 1 or 2 of the following green vegetables: Spinach, string beans, green peas, celery (stewed), asparagus, raw sliced tomatoes, Brussels sprouts, $1\frac{1}{2}$ ounces (45 Gm.). For dessert, the patient may take plain rice pudding, junket, cup custards (all slightly sweetened), or fruit (except strawberries and bananas) either raw or cooked, 4 to 5 ounces (120 to 150 Gm.). The patients may take 4 to 5 ounces (120 to 150 c.c.) of water when fruit is not used. Additionally, a glass of water on rising and three hours after each meal is to be taken, and during the warm season from 1 to 3 glasses over this amount. Thus the patient receives about 175 Gm. ($5\frac{2}{3}$ ounces) of carbohydrates and 250 Gm. ($8\frac{1}{3}$ ounces) of protein daily.

In *obesity associated with or dependent on gout*, the nitrogenous elements are reduced to about 150 Gm. (5 ounces), and 40 to 50 Gm. ($1\frac{1}{3}$ to $1\frac{2}{3}$ ounces) of fat, principally in the form of butter and cream, as well as an additional $\frac{1}{2}$ liter (pint) of water, are allowed. In general, it may be said to be unwise to restrict too greatly the fluid intake in cases in which the protein materials are prescribed in excess of the usual

amounts, since it permits retention of the products of nitrogenous metabolism.

In the *anemic type*, which early shows hydremic or even dropsical tendencies, restriction of fluids must be rigidly enforced, the total amount permitted not exceeding 1 liter (quart). According to Perry there are cases in which an excessive amount of water (serum) in the tissues is practically the sole cause of the corpulency. **Ranke's normal diet** is recommended: Meat, 280 Gm. ($9\frac{1}{3}$ ounces); fat, 100 Gm. ($3\frac{1}{3}$ ounces); bread, 400 Gm. ($13\frac{1}{3}$ ounces), and the limitation of the amount of the fluid taken, allowing only from 300 to 400 c.c. (10 to $1\frac{1}{3}$ ounces) more of water to be ingested daily in food and drink than the daily amount of urine secreted.

These subjects require nutritious aliment, as tender meats, eggs, milk, green vegetables in normal amount, with moderate restriction of the fats and carbohydrates. The appetite shows impairment in many cases, and the patients insist often on a light lunch between meals and on retiring. According to Anders, this should be allowed, and among the best dishes for the purpose are a cup of hot broth or bouillon with part of a French roll, a glass of milk with a graham wafer, a thin sandwich of scraped beef or chicken, or the like.

Strauss tried the **Karell cure**, with good results. The patient is allowed only a glass of milk 4 or 5 times a day for 3 days, and is kept in bed. The patients lost from 5 to 10 pounds, and even more when the diet was kept up a few days longer; but the principal result was obtained in the first 3 days. It is ascribed to the lack of salt and the fluid restriction.

Balneotherapy promotes oxidation, although less actively than muscular

exercise. **Cold- or salt- water baths** of brief duration, followed by active **hand-rubbing** by the patient himself, are to be advised and encouraged. If, however, gouty manifestations or other contraindications exist, then **warm baths**, which aid elimination through the sweat-glands, should be employed. Warm baths are also advocated by Kisch in obesity of endocrin causation, while **carbon-dioxide baths** were found useful for patients with arteriosclerosis and abdominal gaseous distention.

In some cases, a sweat in an **electric-light cabinet** followed by a **cold shower**, at intervals of 2 or 3 days, gives excellent results. Gradually, **cool baths** are to be employed in lieu of cold baths among feeble or highly susceptible individuals. J. M. Anders (Atlantic Med. Jour., May, 1924).

Certain **spas**, especially **Carlsbad**, are effective in the plethoric, but not in the anemic type of obesity. In the latter form, milder aperient waters containing iron are often useful. Again, patients presenting serious cardiovascular diseases should not visit these spas. Among watering-places suitable for the moderate grades of plethoric obesity may be mentioned **Vichy** and **Brides-les-Bains** abroad, as well as **Saratoga** and the **Virginia Hot Springs** at home. While the results obtained at these spas are often striking, they are rarely permanent unless the patient can be enjoined to continue certain details of treatment afterward.

Organotherapy.—Use of **thyroid gland** in the treatment of every case of obesity is seriously to be condemned. The cause or pathogenesis should always be taken into account when treatment is considered. If this is done, it will be found that thyroid

is indicated in less than one-half of the cases. It is of marked benefit, however, in patients in whom deficient thyroid activity, *i.e.*, hypothyroidism, or larval myxedema, exists, which is the case more frequently than is generally supposed. These patients, by the way, are often treated for rheumatism, there being pain or sensitiveness in the occipital region, migraine, or aching between the shoulder-blades. A diagnostic feature of importance is that rest in bed tends to aggravate the pain rather than relieve it. There is premature alopecia or grayness and, in women, "leakage" or stained leucorrhea in the absence of local lesions. While thyroid is of curative value here, large doses should not be employed, 1 to 2 grains (0.06 to 0.12 Gm.), *t.i.d.*, being a limit which cannot be exceeded without danger. Basal metabolic determinations are of assistance in the proper regulation of dosage.

In an experience covering 18 to 20 years, **thyroid** proved very efficient in the great majority of cases. Occasionally, in women, it was combined with **ovarian substance**. The dose of thyroid is from $\frac{1}{4}$ to 6 grains (0.015 to 0.4 Gm.) of the U. S. P. product, [Thyroidum] 3 times a day. The physician should weigh his patient every 5 to 7 days until the dose in the given case has been established, aiming to secure an average diminution in weight of $\frac{1}{2}$ pound a week. C. L. Graber (Surg., Gyn. and Obst., July, 1923).

Obesity of thyroid origin must be suspected when a rapid gain of weight occurs with slight symptoms of hypothyroidism, puffiness of the feet, apathy, diminution of memory, and subjective feelings of cold. The basal metabolism is usually subnormal, and should be investigated. **Thyroid** acts as a specific in these cases and can be used as a functional test. Tolerance

for it is high, while food withdrawal is tolerated badly. Cure by thyroid is rapid and complete. It should be given in gradually increasing doses, starting with $\frac{1}{2}$ grain (0.03 Gm.) once a day, and working up till 1 to 2 pounds a week are lost. This rate of loss should be maintained, though as the tolerance increases further increase of dose may be necessary. The dosage can be more accurately regulated by repeated estimations of the basal metabolism, an attempt being made to keep it at about +10. Marked pulse acceleration or glycosuria indicates temporary withdrawal or reduction. H. Gardiner-Hill (Lancet, Nov. 14, 1925).

Another class of cases in which thyroid proves advantageous is that in which a gouty tendency is clear, especially where asthma, migraine, or recurrent eczema have been present. Here thyroid and regulation of diet are very helpful.

Thyroid should be used only when strictly indicated and in moderate doses, and, moreover, only when the patient can be examined frequently, in order that its use may be temporarily discontinued as soon as the heart shows an acceleration of 10 beats or more (in the sitting position). A rise of pulse-rate above 100 and restlessness are the signals for temporary interruption of the remedy, to be later resumed in smaller dosage. In cases requiring intermittent use of thyroid indefinitely Anders has found administration during every third week usually sufficient.

It must be borne in mind in this connection that American preparations (U. S. P.) of thyroid gland are equivalent to 5 grains (0.3 Gm.) of the fresh gland per grain of desiccated gland, while an English preparation (Burroughs and Wellcome's), considerably used, equals but 1 grain of fresh gland.

Treatment of obesity with extracts of single organs is unsatisfactory. The

writer has long used **lipolysin** (Herring), with good results. It is a mixture of thyroid, pituitary, pancreas and gonads. There is a lipolysin masculin, containing testicle, and a lipolysin feminin, containing ovary. Lipolysin causes at first marked diuresis and relief of the spastic constipation. During the early part of the treatment the fluid intake should be reduced, and carbohydrates and fat restricted. Best results with lipolysin were obtained when injections were given every other day and 2 tablets by mouth on the intervening day. A. Alexander (Deut. med. Woch., Mar. 7, 1924).

In the forms due to excessive adrenal activity, thyroid would but add fuel to the fire, since one is already dealing with exaggerated metabolism.

The obesity of castration is greatly benefited by thyroid, but along with **ovarian extract** or **corpora lutea**.

There is a form of obesity involving the lower extremities in women from puberty to the menopause. Menstruation is late and irregular, and some asthenia and anemia coexist. The treatment is complete rest at first, a suitable diet, thyroid gland, 0.2 Gm. (3 grains) a day, together with **ovarian** and **pituitary extracts**, discontinued every third week, if any signs of toxic action appear. The author also injects hypodermically **adrenalin**, 0.5 mgm. ($\frac{1}{30}$ grain) in 5 c.c. (80 minims) of saline solution, to stimulate the depressed sympathetic nervous system. When the weight has been restored to about normal, he completes the cure by ordering vigorous exercises, especially **bicycle riding**, with the legs in heavy woolen underwear. In the diet, starches, sugar, and fats are restricted, and rare meats, salads, and fruits largely depended upon. F. Heckel (Bull. méd., Feb. 11, 1922).

In the types of *pituitary origin*, Fröhlich's syndrome and Dercum's adiposis dolorosa, **pituitary gland** is at times of service, though the prolonged use of **thyroid** seems of greater

benefit. The two preparations may with advantage be given together.

Between 70 and 80 per cent. of juvenile adiposities are of pituitary origin. In such cases **pituitary whole gland substance**, 10 grains (0.65 Gm.) in salol-coated capsules after meals, and what the author terms "a tolerant dose of **pituitrin** hypodermically" twice weekly, are serviceable.

The annexed illustrations indicate the type referred to, in which both lobes of the pituitary are held to be functionally inadequate. Fig. 1 represents a girl of 13 years in whom the pituitary treatment had just been started. Fig. 2 represents a girl of 15 years, a case of the same class, though perhaps less marked, in which the treatment described had restored normal body conformation, reduced the weight 17 pounds and caused the menstruation, which had been very irregular, with prolonged absences, to become regular. Engelbach (*Ann. of Clin. Med.*, Sept., 1924).

A clear identification of the cause is no less necessary in the ordinary types of obesity. To administer thyroid or any ductless gland to an excessive eater simply increases his appetite; here the **dietetic treatment, exercise in the open air and massage** are sheet anchors. In cases traceable to emotions, fright, and shock, thyroid will soon bring on rapid heart action, dyspnea, and other morbid phenomena. Obesity following traumatism may be classed in the same category. This applies also to cases that follow infectious diseases, intoxications, hemorrhage, anemia, and chlorosis, the treatment here being that of the causative disease.

Late researches having shown that the *lungs* play an important rôle in breaking down fats, these organs should be taken into consideration in treatment. The vital capacity and hourly rate of pulmonary ventilation should be investigated in all cases and

respiratory exercises, *e.g.*, with Pescher's spiroscope, prescribed. **Lung and liver extracts** may be tried, to stimulate the lipolytic functions of these organs. The possibility of *chloride retention* as a cause of overweight should also be looked into. In subjects unable to eliminate or neutralize toxic materials properly through the kidneys or liver, obesity may result from the fact that the toxic materials are fixed and made harmless by the fats. Prével (*Presse méd.*, Aug. 12, 1922).

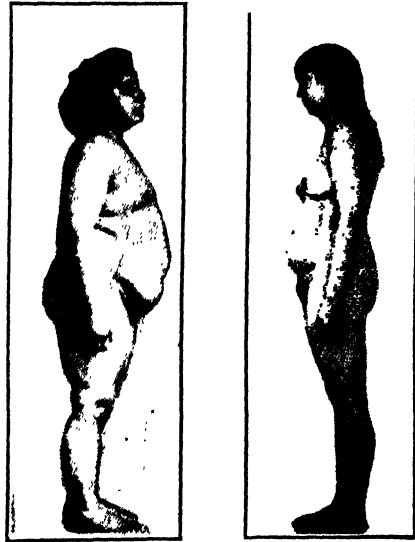


Fig. 1.

Fig. 2.

Pituitary obesity. (Engelbach, in *Ann. of Clin. Med.*)

The surgical removal of slabs of fat, *i.e.*, **lipectomy**, has been advocated and may serve a good purpose in patients in whom great deformity and interference with one or more functions (*e.g.*, menstruation) exist.

It has been amply demonstrated that superfluous masses of subcutaneous abdominal fat can, with advantage to the patient, be removed by operation. The writer adds 11 personal cases to 77 culled from the literature. The risks of **lipectomy** are slight, but 2 out of 88 cases (both operated also for hernia) having died.

Removal of one large wedge-shaped fat block, occasionally 2, rarely, 3, usually suffices. A. P. Heineck (West. Med. Times, Oct., 1925).

Electricity has been recommended, but its effects are fleeting; it may, however, be used as an adjuvant. The Bergonié system of **faradization**, in which isolated parts of the muscular system are excited to rhythmic regulated action, was regarded by Bergonié himself as being but one factor in the treatment of obesity.

C. E. DE M. SAJOUS,
Philadelphia.

OCCULT BLOOD.—Occult blood is blood which cannot be detected on gross examination. It may be found: In the feces, in cases of duodenal ulcer and in malignant disease of the intestinal tract; in the urine, in cases of renal or ureteral calculus and in ulceration and malignant disease of the urinary organs; and in the gastric contents, in cases of gastric ulcer or malignant disease.

Nearly all the chemical tests for blood depend upon the power of the blood to cause the oxidation of various chromogenic substances by means of oxidizing agents of the hydrogen-dioxide type, the blood acting as an oxygen carrier in this connection, not, as was formerly believed, by reason of a contained oxidase or peroxidase, but by reason of its iron content (boiling will destroy the oxidases, but as long as iron is present the reaction can be obtained). The blood appears to seize the oxygen of the oxidizing agent and to deliver it up to the chromogenic substance, thus producing the characteristic color.

A number of chromogenic substances have been used for this purpose,—guaiac, aloin, the leuco-base of malachite green, benzidin, phenolphthalin (not phenolphthalein), tolidin (orthotolidin), etc.,—and various oxidizing agents—ozonized turpentine, hydrogen dioxide and perhydrol, ozonized ether, etc.,—giving rise to many tests, the best known being Van Deen's guaiac, Rossel's aloin, Schuman's benzidin, and Kastle's phenolphthalin tests, with various modifications of each.

PRELIMINARY PRECAUTIONS.—

Many substances, such as pus, mucus, and various animal and vegetable ferments which can themselves give a positive reaction, must be excluded by boiling the suspected secretion or excretion. When the feces are to be examined, the patient must refrain from the use of meat, and is kept on a lactovegetarian diet, or, better, a strict milk diet, for from three to ten days before the test. The test itself must be immediately preceded by a cleansing enema, and the suspected stools, secured later, must be boiled and cooled for the test. The swallowing of blood-stained sputa and the presence of hemorrhoids may give rise to error. The stools may be "marked off," if desired, by adding carmine to the milk. Again, the secretions and excretions may contain substances that have a reducing action, *i.e.*, one of seizing and appropriating the oxygen of the oxidizing substance, so that none is available to oxidize the reagent.

An attempt at provocation of occult bleeding is advocated by the writer in cases where the tests are negative notwithstanding suspicion of a gastric or duodenal ulcer. The provocation is carried out by applying a hot dressing over the epigastrium every 20 minutes, with short intervals between applications, for 2 days. I. Boas (Deut. med. Woch., Feb. 26, 1926).

TECHNIQUE.—The guaiac, benzidin, hematin and other tests for occult blood in the urine have already been described (see HEMATURIA, Volume V). Their application in the examination of the feces for occult blood will suggest itself, after the patient and the feces have been properly prepared.

The stool to be examined is dried and a 2 per cent. emulsion of it is made and boiled.

The reagents may be made up as follows: Guaiac in methylated spirit, 1:25; benzidin and tolidin in solutions of similar strength, but in glacial acetic acid; the phenolphthalin reagent is difficult of preparation outside of a well-equipped laboratory, is very unstable, and may be omitted here.

The oxidizing agent used is hydrogen dioxide, or, better, perhydrol diluted with redistilled water down to about 3 per cent.

For the test, 1 c.c. each of the reagent and the emulsified stool are first mixed in a test-tube, and then, in all cases, 1 c.c. of hydrogen dioxide is added (except when the phenolphthalin solution, which already contains it, is used), and the whole is carefully shaken. If the amount of occult blood is small the reagent solution should be diluted, as a strong solution would mask the weak reaction.

The reaction color with the guaiac reagent is green, then brownish red, then violet, and finally blue; with the benzidin reagent, green (appearing promptly), turning to a dirty purple after 5 to 15 minutes; with aloin, red; with phenolphthalin, red to pink; with tolidin reagent, a green to a blue black, depending on dilution, which appears gradually and increases in intensity, lasting sometimes several hours.

A negative reaction denotes the absence of blood; a positive reaction should be confirmed by the microscope and spectroscope.

Previous to tests for occult blood Bassler prefers to extract the hemoglobin by treating the gastric filtrate or $\frac{1}{2}$ test-tube of a watery solution of feces with $\frac{1}{3}$ volume of glacial acetic acid and $\frac{1}{2}$ volume of ether. The mixture, after thorough shaking, is allowed to stand for 15 minutes or until there has occurred complete separation of the ether, which will contain the hemoglobin. The separation may be hastened, if necessary, by adding a few drops of ethyl alcohol or by centrifugating.

The *Gregersen modification of the benzidin test* is recommended by E. Adler (Arch. f. Verdauungskr., xxvii, 153, 1921) for the detection of cancer through blood in the gastric contents or stools. A 0.5 per cent. benzidin solution is made with 0.025 Gm. of benzidin and 0.1 Gm. of barium peroxide in 5 c.c. of 50 per cent. acetic acid. Two to 4 drops of this solution are dropped on a thin layer of the stool on a slide, and the amount of blood present is estimated by the time required for a *greenish-blue color* to develop. If distilled water is used in making the test, previous exclusion of chlorophyll-containing foods is not necessary. To distinguish occult blood from hemorrhoidal blood, as well as for the detection of hematoporphyrin alone, a little ether with hydrochloric acid is added to an acetic-acid-ether extract.

J. Vandrofy (Arch. f. Verd., Dec., 1923) uses the *Schroeder modification of the Weber guaiac test*. There is added to the feces tincture of guaiac in 3 different concentrations, viz., a wine-yellow concentration, a straw-yellow concentration, and finally a clear concentration of guaiac resin in alcohol; 20 drops of 3 per cent. hydrogen peroxide are then added, and 5 to 10 drops of glacial acetic ether extract.

Spectroscopic examination of the feces for occult bleeding is not of great diagnostic value in ulcer cases. The most sensitive methods are negative in 25 per cent. of gastric or intestinal ulcer cases, and are positive in 40 per cent. of other diseases, even on a diet free from meat and vegetables. In malignant tumors, there are regularly considerable quantities of blood in the feces. It is, however, necessary to test for hematoporphyrin, because the blood may be decomposed to that stage. While the absence of a spectrum of hematoporphyrin testifies against a malignant tumor in the stomach or intestine, its presence does not prove malignancy. Snapper (Arch. des mal. de l'app. dig., Oct., 1924).

Certain substances other than blood react with guaiac and other chromogenic substances employed in blood examination, alone or with hydrogen dioxide; among them are: The halogens, ozone, ammonia, finely divided metals, compounds of certain heavy metals (cobalt, copper, gold, iron, lead, manganese, and silver salts, and mercuric chloride); substances of animal origin (animal ferments, ash of blood, gelatin, milk, organic secretions—bile and mucus, feces after diet of raw or cooked meat or foods containing blood, nasal mucus, pus, saliva, leucocyte-bearing secretions, red flesh, albumin, peptone, sweat); many substances of vegetable origin (especially asparagus, beans, peas, onions, potatoes, tomatoes, fresh walnuts, fruits and berry juices, watermelon pulp, etc.); many organic substances (alcohol, amyl nitrite, aniline, ether, many aldehydes, nitrous ether, etc.); certain medicinal preparations; certain phosphorizing substances; flannel, ink stains, leather, papers (especially filter-paper and glazed papers containing alum), and soap (J. H. Kastle). W.

OCCUPATIONAL DISORDERS.

—Legislation is increasingly being enacted to protect workers in aniline dyes, lead, phosphorus, arsenic, mercury and their compounds, wood or methyl alcohol, compressed air, etc. All these disorders, as well as many other occupational disturbances, will be found described in this work under their respective headings or under those of the organs affected.

OCCUPATIONAL THERAPY.

—The fundamental principle of occupational therapy may be said to be a psychologic one, *viz.*, the replacement of the scattered activities or idleness commonly attending weakness of the body or mind by a purposeful coördinated activity. The latter, through the continued endeavor entailed, may be expected not only to enhance nervous activity in a particular, wholesome direction, with exclusion of prejudicial morbid introspection, but through the dispersion of the stimulus thus awakened to other nervous structures, to benefit nutrition as a whole. In addition, the element of remuneration or payment for support through services rendered frequently assists in elevating the morale of the afflicted persons, besides indirectly promoting better care of their condition through increased facilities.

As noted by Cullimore, the first need is a thorough examination and enlightened diagnosis. The occupational and social history should be gone into, and often a simple mental test is very helpful. A single, definite objective should then be determined upon, and such work given as will lead directly to it. H. A. Pattison divides occupational therapy into 3 parts, *diversional*, *handicraft*, and *prevocational*. In the earlier forms, there are limitations to the variety of tasks, but in the prevocational period, as developed in relation to quiescent **tuberculous cases**, many odd forms of light work have been introduced. Istvan describes 3 stages of occupational therapy for those recovering from tuberculosis, the first group working at sewing, drawing, or cutting paper; the second, doing light work in the garden, setting the table, washing the dishes, etc., and the third, cleaning the floor, windows, and yard, bathing other patients, and doing heavier work in

the garden, together with carpentering. The weaving of baskets is also a serviceable pursuit. Describing an experiment conducted at the Phipps Institute in an attempt to develop suitable employment for arrested cases of tuberculosis, Landis (Amer. Rev. of Tuberc., June, 1922) noted that from the medical standpoint the experiment was an unqualified success, and though financially a failure, gave hope of better financial results under favorable conditions. The actual time the individuals are employed must be under the control of a physician. Specialties, the demand for which is dictated by fashion, are unsuitable as objects of manufacture by these cases. If staple competitive articles, such as ready-made wearing apparel, are to be produced and a business success made, the workers have to be employed at high speed for whatever time they are at work and a fair proportion of skilled, healthy workers employed to set standards and take up the slack.

Occupational therapy is also being availed of in **surgical cases**, following experience with the later stages of war injuries. J. H. Arnett (Jour. Amer. Med. Sci., July, 1921), describing a series of appropriate procedures, laid stress on its possibilities in cases with paralysis, contracture, fibrosis, or lack of coördination. In painless lesions involving the upper extremity, clay modelling is by far the best occupation. Where the finger- or wrist-joints are deformed, wood polishing is best. For limitation of motion of the shoulder, sweeping movements, such as polishing windows or tables, or wood chopping, are valuable. Where fibrosis limits the knee or hip movements, propelling a lathe or jig-saw with the feet, with the seat gradually raised, is helpful. To maintain nutrition of muscles in uncomplicated paralysis, carpentry, metal work, book binding, weaving, and toy making are particularly useful. For muscles that are recovering, stress is to be laid on accuracy of the work done, musculospiral cases using the carpenter's mallet and chisel, elbow cases the coping saw, and intrinsic hand muscle cases, type setting, type writing, bead work, knitting, and penmanship. The advantage of occupational therapy over other forms of mechanical treatment lies in that inter-

esting work secures repetition of movements without undue fatigue.

OLIVE OIL.—Olive oil (*oleum olivæ*, U. S. P.) is a fixed oil expressed from the ripe fruit of *Olea Europæa*, (nat. ord., Oleaceæ), or olive tree, indigenous to the countries bordering upon the Mediterranean, but cultivated in all the semi-tropical countries of the world. It is yellow or greenish yellow in color, has a sweetish taste, and is almost devoid of odor. The greenish-yellow-colored oil is considered the most delicate, and is rarely an article of export. The best, or virgin, oil is obtained from the crushed, ripe fruit, by expression without heat; a second grade is obtained by the addition of hot water to the same crushed fruit and a second expression. From the residue, after boiling, an inferior grade is made by means of very strong pressure. Olive oil is miscible with ether, chloroform, benzene, benzin, and carbon disulphide, and is slightly soluble in alcohol.

THERAPEUTICS.—Olive oil is a lubricant, laxative, and nutrient. Internally and by enema it is given for **constipation**, in doses of from $\frac{1}{2}$ to 6 ounces (15 to 200 c.c.). The oil is a soothing laxative in cases of **hemorrhoids** and **fissure of the anus**. It is a useful remedy in **irritant poisoning**, except that by phosphorus. In increasing doses of from $\frac{1}{2}$ to 3 ounces it has caused the disappearance of **obstructive jaundice**. It has been used in the treatment of **gall-stone**, **hepatic**, and **lead colic** in doses of 3 to 6 ounces. Bram has relieved most stubborn cases of lead colic and the accompanying persistent constipation by the use of a tumblerful of olive oil once daily. Free catharsis occurred on the second or third day and the nervous symptoms subsided.

In obstinate and painful cases of **dry pleurisy** the injection of $\frac{1}{2}$ dram (2 c.c.) of sterilized olive oil into the pleural sac, over the site of the friction sounds, often gives prompt relief.

In young children and infants good results have been obtained by the inunction of 1 dram (4 c.c.) of olive oil once or twice daily. Infants with **constipation** and **malnutrition** improve under 1 dram (4 c.c.) administered once or twice daily.

Olive oil has been used by inunction, or as an article of diet, in **wasting diseases**. For this purpose, however, it is much inferior to codliver oil. When given by mouth it is best administered cold in gradually increasing doses, about 2 hours after meals, either alone or flavored with glycerin, orange-juice, coffee, or sarsaparilla syrup (Bram).

Rectal enemas of olive oil are highly beneficial in **mucous colitis**, the **constipation of neurasthenia**, and **intestinal atony**.

In **chronic dysentery** excellent results have followed the continued use of olive oil given in large quantities. The dose, starting with 1 ounce (30 c.c.) three times a day, is gradually increased to 4 ounces (125 c.c.). In **gastric ulcer**, according to Cohnheim, olive oil relieves the pain, lubricates the surfaces of the ulcers or fissures, reduces hyperacidity, and acts as an easily digested food.

Ferguson has called attention to the use of olive oil as a speedy restorative of the patient's power to resist **infection**. He advises, in connection with anesthesia, a high rectal injection of 6 ounces (200 c.c.) of olive oil in all **septic cases**.

Graham found olive oil useful in **post-anesthetic nausea and vomiting**. As soon as the patient began to recover consciousness, it was given in doses of 1 ounce (30 c.c.), and in most cases the usual nausea did not appear. In other cases in which nausea was already present, the oil brought about its cessation.

Externally olive oil is a soothing application to **burns**, **wounds**, and **raw surfaces**. Dropped into the ear, it is a useful means for expelling **insects**.
W.

OPIUM AND DERIVATIVES.

—Opium, as officially recognized, is the concrete, milky exudation obtained by incising the unripe capsules of *Papaver somniferum* (family, Papaveraceæ), or white poppy-plant, an annual herb indigenous to Asia, and now cultivated in Asia Minor, China, India, and Persia. It occurs in moist, semisolid chestnut-colored masses or lumps, weighing about $\frac{1}{2}$ to 2 pounds, with an earthy, narcotic odor and a bitter taste. The

crude drug, in its normal, moist condition, is required officially to contain not less than 9.5 per cent. of anhydrous morphine.

The principal active substances of opium may be extracted by water, alcohol, and by dilute acid, but not by ether. The chemical composition of the drug is very complex. Over twenty alkaloids have been found in it, including *morphine* (5 to 22 per cent.), *codeine* (0.2 to 0.7 per cent.), *narcotine* (1 to 10 per cent., average 6 per cent.), *narceine* (0.1 to 0.2 per cent.), *papaverine* (1 per cent.), and *thebaine* (0.15 to 1 per cent.), together with small amounts of pseudomorphine, codamine, laudanine, laudanoline, oxynarcotine, papaveramine, meconine, meconidine, lanthopine, cryptopine, hydrocotarnine, protopine, rheadine, gnoscopine, and tritopine. In addition there are present meconic acid in combination with the alkaloids; lactic acid, wax, meconates of calcium and magnesium, meconoisin, etc.

Among the alkaloids of the morphine-codeine group not contained in opium, but prepared artificially in the laboratory, are: (1) *Heroine*, or diacetyl morphine. (2) *Dionin*, or ethyl-morphine hydrochloride. (3) *Peronin*, or benzyl-morphine hydrochloride. (4) *Apomorphine*, derived from morphine by dehydration. (5) *Apocodeine*, derived from codeine by dehydration. Of these, apomorphine has already been considered (see *APOMORPHINE*). The remaining four will be discussed serially at the close of the sections Preparations and Dose, and Physiological Action, in this article.

PREPARATIONS AND DOSE.

A. Solid Preparations.—*Opium*, U. S. P. (opium; gum opium), containing not less than 9.5 per cent. of morphine.

Dose, $\frac{1}{2}$ to 3 grains (0.03 to 0.2 Gm.); average, 1 grain (0.06 Gm.), containing about $\frac{1}{10}$ grain (0.006 Gm.) of morphine.

Opium granulatum, U. S. P. (granulated opium), consisting of opium dried at a temperature not exceeding 70° C. and reduced to a coarse powder. It is required to contain 10 to 10.5 per cent. of morphine. Dose, $\frac{1}{2}$ to 2 grains (0.03 to 1.3 Gm.); average, 1 grain (0.06 Gm.).

Opium pulveratum, U. S. P. (powdered opium; formerly *Opii pulvis*), consisting of opium dried at a temperature not exceeding 70° C. and reduced to a very fine powder. It contains 10 to 10.5 per cent. of morphine. Dose, $\frac{1}{2}$ to 2 grains (0.03 to 1.3 Gm.); average, 1 grain (0.06 Gm.).

Pulvis ipecacuanhae et opii, U. S. P. (powder of ipecac and opium; Dover's powder), containing ipecac and powdered opium, of each, 1 part; lactose, 8 parts. Dose, 5 to 15 grains (0.3 to 1 Gm.); official dose, 5 grains (0.3 Gm.), containing $\frac{1}{20}$ grain (0.003 Gm.) of morphine.

Pilulae opii, U. S. P. IX (pills of opium), each representing 1 grain (0.065 Gm.) of powdered opium. Dose, 1 pill, containing about $\frac{1}{8}$ grain (0.008 Gm.) of morphine.

Trochisci glycyrrhizae et opii, U. S. P. VIII (troches of licorice and opium; Wistar's cough lozenges), containing $\frac{1}{12}$ grain (0.005 Gm.) of powdered opium— $\frac{1}{100}$ grain (0.0006 Gm.) of morphine,—together with extract of licorice, acacia, sugar, and oil of anise.

Emplastrum opii, U. S. P. VIII (opium plaster), made by rubbing 6 parts of extract of opium with 8 parts of water, adding 90 parts of adhesive plaster—previously melted—and con-

tinuing to heat, with constant stirring, until the total product equals 100 parts.

B. Fluid Preparations.—*Tinctura opii*, U. S. P. (tincture of opium; laudanum; same as *Tinctura opii deodorati*, U. S. P. IX), a 10 per cent. preparation of granulated opium, required to yield from each 100 c.c., 0.95 to 1.05 Gm. of anhydrous morphine. Dose, 1 to 20 minims (0.06 to 1.25 c.c.); official dose, 10 minims (0.6 c.c.).

Tinctura opii camphorata, U. S. P. (camphorated tincture of opium; paregoric), representing 0.4 per cent. of powdered opium, together with 0.4 per cent. each of benzoic acid, camphor, and oil of anise, 4 per cent. of glycerin, and 95 per cent. of diluted alcohol. Each fluidram (4 c.c.) of the tincture contains about $\frac{1}{30}$ grain (0.002 Gm.) of morphine. Dose, 1 to 4 fluidrams (4 to 16 c.c.); official dose, 1 fluidram (4 c.c.).

Acetum opii, U. S. P. VIII (vinegar of opium; black drop), representing 10 per cent. of powdered opium, extracted with diluted acetic acid. It also contains 20 per cent. of sugar and is flavored with nutmeg. Dose, 5 to 15 minims (0.3 to 1 c.c.); average, 8 minims (0.5 c.c.).

Vinum opii, U. S. P. VIII (wine of opium; Sydenham's laudanum), representing 10 per cent. of granulated opium, extracted with white wine. The menstruum of the finished preparation is a mixture in equal parts of white wine and alcohol, and is flavored with cinnamon and cloves. Dose, 1 to 20 minims (0.06 to 1.25 c.c.); average, 8 minims (0.5 c.c.).

Opium, in small amount, is present in the compound licorice mixture:—

Mistura glycyrrhizæ composita, U. S. P. (compound mixture of glycyrrhiza;

brown mixture), each 2 fluidrams (8 c.c.) of which contain approximately 15 minims (1 c.c.) each of camphorated opium tincture, fluidextract of licorice, and glycerin, $\frac{1}{32}$ grain (0.002 Gm.) of tartar emetic, and 4 minims (0.25 c.c.) of spirit of ethyl nitrite. Dose, 1 to 4 fluidrams (4 to 16 c.c.); official dose, 1 fluidram (4 c.c.).

C. Alkaloidal Preparations.—*Morphinæ hydrochloridum*, U. S. P. (morphine hydrochloride) [$C_{17}H_{19}NO_3 \cdot HCl \cdot 3H_2O$], occurring in white, glistening needles or cubical masses, or as a crystalline powder, odorless, bitter, and permanent in the air. One Gm. is soluble in 17.5 c.c. of water and in 52 c.c. of alcohol; it is insoluble in ether or chloroform. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); official average dose, $\frac{1}{8}$ grain (0.008 Gm.).

Morphinæ sulphas, U. S. P. (morphine sulphate) [$(C_{17}H_{19}NO_3)_2H_2SO_4 \cdot 5H_2O$], occurring in white, acicular crystals or cubical masses, odorless, bitter, and permanent in the air. One Gm. is soluble in 15.5 c.c. of water and in 565 c.c. of alcohol; it is insoluble in ether or chloroform. Dose, $\frac{1}{12}$ to $\frac{1}{2}$ grain (0.005 to 0.03 Gm.); official average dose, $\frac{1}{8}$ grain (0.008 Gm.).

Codeina, U. S. P. (codeine; codeia; methylmorphine) [$C_{18}H_{21}NO_3 \cdot H_2O$], occurring in colorless, translucent crystals or as a crystalline powder, odorless, with a faint, bitter taste, and slightly efflorescent in warm air. One Gm. is soluble in 120 c.c. of water, 2 c.c. of alcohol, 18 c.c. of ether, and 0.5 c.c. of chloroform. Dose, $\frac{1}{8}$ to 2 grains (0.015 to 0.12 Gm.); official average dose, $\frac{1}{2}$ grain (0.03 Gm.).

Codeinæ phosphas, U. S. P. (codeine phosphate) [$C_{18}H_{21}NO_3 \cdot H_3PO_4 \cdot$

.2H₂O], occurring in fine, white needles or a crystalline powder, odorless, and with a bitter taste. One Gm. is soluble in 2.3 c.c. of water and in 325 c.c. of alcohol; it is practically insoluble in ether or chloroform. Dose, $\frac{1}{8}$ to 2 grains (0.015 to 0.12 Gm.); official average dose, $\frac{1}{2}$ grain (0.03 Gm.).

Codeine sulphas, U. S. P. (codeine sulphate) [(C₁₈H₂₁NO₃)₂.H₂SO₄.5H₂O], occurring in long needles, rhombic prisms, or as a crystalline powder, odorless, and with a bitter taste. It effloresces in the air. One Gm. is soluble in 30 c.c. of water and in 1280 c.c. of alcohol; it is insoluble in ether and chloroform. Dose, $\frac{1}{8}$ to 2 grains (0.015 to 0.12 Gm.); official average dose, $\frac{1}{2}$ grain (0.03 Gm.).

Morphina, U. S. P. IX (morphine, morphia) [C₁₇H₁₉NO₃.H₂O], occurring in colorless rhombic prisms or fine needles, odorless, bitter, and permanent in the air. It is soluble only in 3330 parts of water, and also practically insoluble in ether and chloroform, but dissolves in 168 parts of alcohol and in 100 parts of lime-water. Dose, $\frac{1}{16}$ to $\frac{1}{3}$ grain (0.004 to 0.02 Gm.); average, $\frac{1}{5}$ grain (0.012 Gm.).

Pulvis morphinæ compositus, U. S. P. VIII (compound powder of morphine; Tully's powder), containing 1.5 per cent. of morphine sulphate, 32 per cent. of camphor, 33 per cent. of licorice, and 33.5 per cent. of precipitated chalk. Dose, 5 to 15 grains (0.3 to 1 Gm.); average, $7\frac{1}{2}$ grains (0.5 Gm.), containing $\frac{1}{8}$ grain (0.0075 Gm.) of morphine sulphate.

D. Semiofficial Preparations.—

Extractum opii, N. F. (extract of opium; powdered extract of opium), made by extraction of powdered

opium with water and addition of enough dried starch to bring the morphine content of the finished drug extract to 20 per cent. Dose, $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.); average, $\frac{1}{2}$ grain (0.03 Gm.), containing $\frac{1}{10}$ grain (0.006 Gm.) of morphine.

Tinctura ipecacuanhæ et opii, N. F. (tincture of ipecac and opium; tincture of Dover's powder), representing an equal volume of tincture of opium with the addition of 10 per cent. by volume of fluidextract of ipecac. It therefore contains 10 per cent. of opium and 1 per cent. of ipecac. Dose, 5 to 15 minims (0.3 to 1 c.c.); average, 8 minims (0.5 c.c.).

Tinctura opii crocata, N. F. (tincture of opium with saffron; Sydenham's laudanum), representing 10 per cent. of powdered opium, 2.5 per cent. of saffron, and 0.6 per cent. each of cinnamon and clove. Dose, 10 minims (0.6 c.c.).

Tinctura opii et gambir composita, N. F. (compound tincture of opium and gambir; guttæ pectorales; pectoral drops; Bateman's pectoral drops), containing 4.2 per cent. of tincture of opium, 6.4 per cent. of compound tincture of gambir, 4 per cent. of spirit of camphor, 0.1 per cent. of oil of anise, and 1 per cent. of caramel. Dose, for infants, 10 minims (0.6 c.c.).

Pilula opii et camphoræ, N. F. (pills of opium and camphor), each containing about 1 grain (0.065 Gm.) of powdered opium and 2 grains (0.13 Gm.) of camphor. Dose, 1 pill.

Pilula opii et plumbi, N. F. (pills of opium and lead), containing about 1 grain (0.065 Gm.) each of powdered opium and lead acetate. Dose, 1 pill.

Pilula opii, digitalis et quininæ, N. F. (pills of opium, digitalis and quinine;

Niemeyer pills for phthisis), each containing $\frac{1}{6}$ grain (0.01 Gm.) of powdered opium, and 1 grain (0.065 Gm.) each of digitalis and quinine sulphate. Dose, 1 pill.

Pulvis cretæ et opii aromaticus, N. F. (aromatic powder of chalk and opium), containing 2.5 per cent. of powdered opium, together with cinnamon, nutmeg, clove, cardamom seed, prepared chalk and sucrose. Dose, 15 grains (1 Gm.), containing about $\frac{3}{8}$ grain (0.025 Gm.) of powdered opium.

Mistura carminativa, N. F. (carminative mixture; Dalby's carminative), containing about 12 minims (0.8 c.c.) of opium tincture in each fluidounce (30 c.c.), together with magnesium carbonate, potassium carbonate, and carminative oils. Dose, 1 fluidounce (30 c.c.); in infants, 8 minims (0.5 c.c.).

Mistura pectoralis, N. F. (expectorant mixture; pectoral mixture; Stokes's mixture), each fluidram containing about 10 minims (0.7 c.c.) of camphorated opium tincture, 1 grain (0.07 Gm.) of ammonium carbonate, and 2 minims (0.14 c.c.) each of the fluidextracts of senega and squill, with syrup of Tolu. Dose, 1 to 2 fluidrams (4 to 8 c.c.).

Mistura opii et chloroformi composita, N. F. (compound mixture of opium and chloroform; Squibb's diarrhea mixture), each $\frac{1}{2}$ fluidram (2 c.c.) of which contains about 6 minims (0.4 c.c.) each of tincture of opium and spirit of camphor, 3 minims (0.2 c.c.) of tincture of capsicum, and $2\frac{1}{2}$ minims (0.16 c.c.) of chloroform, with alcohol as menstruum. Dose, 30 minims (2 c.c.).

Mistura opii et rhei composita, N. F. (compound mixture of opium and rhubarb; Sun cholera mixture), each $\frac{1}{2}$ fluidram (2 c.c.) of which contains

about 3 minims (0.2 c.c.) each of the tinctures of rhubarb and capsicum, and 6 minims (0.4 c.c.) each of tincture of opium and the spirits of camphor and peppermint, with alcohol as menstruum. Dose, 30 minims (2 c.c.).

Mistura chloroformi et morphina composita, N. F. (chloroform anodyne), each $\frac{1}{2}$ fluidram (2 c.c.) of which represents about $\frac{1}{13}$ grain (0.005 Gm.) of morphine sulphate, $3\frac{3}{10}$ minims (0.25 c.c.) of chloroform, $5\frac{1}{2}$ minims (0.37 c.c.) of tincture of cannabis, and $\frac{3}{4}$ minim (0.05 c.c.) of tincture of capsicum. Dose, 30 minims (2 c.c.).

Syrupus pini albi compositus cum morphina, N. F. (compound white-pine syrup with morphine), 30 minims (2 c.c.) representing $\frac{1}{60}$ grain (0.0008 Gm.) of morphine sulphate, together with white-pine bark and wild cherry, and small quantities of spikenard, balm of gilead buds, sanguinaria, sassafras, and chloroform. Dose, 30 minims (2 c.c.).

Elixir terpini hydratis et codeinae, N. F. (elixir of terpin hydrate and codeine), each fluidram (4 c.c.) representing about 1 grain (0.07 Gm.) of terpin hydrate and $\frac{1}{9}$ grain (0.008 Gm.) of codeine. Dose, 1 fluidram (4 c.c.).

Lotio plumbi et opii, N. F. (lead and opium wash), containing 1.75 per cent. of lead acetate and 3.5 per cent. of tincture of opium. Shaken before use.

Linimentum opii compositum, N. F. (compound opium liniment), consisting of opium tincture, 10 parts; ammonia-water, 35 parts; alcohol, 25 parts; oil of peppermint, 2.5 parts; camphor, 1.75 parts, fresh egg albumen, 5, and oil of turpentine, to make 100 parts.

Pulvis kino et opii compositus, N. F. IV (compound kino powder), powdered opium, 5 parts, with kino, 75 parts, and

cinnamon, 20 parts. Dose, 15 grains (1 Gm.), containing about $\frac{3}{4}$ grain (0.05 Gm.) of powdered opium.

Mistura camphoræ acida, N. F. IV (acid mixture of camphor; Hope's mixture), each 2 fluidrams (8 c.c.) containing about $1\frac{1}{2}$ minims (0.1 c.c.) of tincture of opium and 21 minims (1.3 c.c.) of nitric acid, the remainder being camphor water. Dose, 2 to 4 fluidrams (8 to 16 c.c.).

Mistura opii et sassafras, N. F. IV (mixture of opium and sassafras; Godfrey's cordial), each fluidram (4 c.c.) containing about 2 minims (0.12 c.c.) of tincture of opium. Dose, 2 fluidrams (8 c.c.); in infants, as anodyne and carminative, 5 minims (0.3 c.c.).

Syrupus morphinæ et acaciæ, N. F. IV (Jackson's pectoral syrup), each fluidram (4 c.c.) containing $\frac{1}{32}$ grain (0.002 Gm.) of morphine sulphate in syrup of acacia, flavored with sassafras. Dose, 1 fluidram (4 c.c.).

Syrupus codeinæ, N. F. IV (syrup of codeine), each fluidram (4 c.c.) containing $\frac{1}{8}$ grain (0.008 Gm.) of codeine sulphate. Dose, 1 fluidram (4 c.c.).

Elixir terpinii hydratis et diacetylmorphinæ, N. F. IV (elixir of terpin hydrate with heroine), each fluidram (4 c.c.) representing 1 grain (0.06 Gm.) of terpin hydrate and $\frac{1}{65}$ grain (0.001 Gm.) of heroine. Dose, 1 fluidram (4 c.c.).

Elixir picis compositum, N. F. III (compound tar elixir), each fluidram (4 c.c.) representing $\frac{1}{50}$ grain (0.0013 Gm.) of morphine sulphate, with syrup of wild cherry, syrup of Tolu, and wine of tar. Dose, 1 to 2 fluidrams (4 to 8 c.c.).

Liquor morphinæ hypodermicus, N. F. III (Magendie's solution), every 5 minims (0.03 c.c.) containing $\frac{1}{6}$ grain (0.01 Gm.) of morphine sulphate in

sterilized water, with a small amount of salicylic acid added as a preservative. Dose, 5 minims (0.3 c.c.).

E. Related Alkaloids.—*Ethylmorphinæ hydrochloridum*, U. S. P. (dionin) $[C_{17}H_{18}(C_2H_5)NO_3.HCl.2H_2O]$, occurring as a white or faintly yellow micro-crystalline, odorless powder, with a slight bitter taste. One Gm. is soluble in about 8 c.c. of water and in 22 c.c. of alcohol. Dose, $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.); official average dose, $\frac{1}{4}$ grain (0.015 Gm.).

Diacetylmorphinæ hydrochloridum, U. S. P. IX (heroine hydrochloride) $[C_{17}H_{17}(C_2H_3O)_2NO_3.HCl]$, seen as a white, crystalline odorless powder, with a bitter taste, soluble in 2 parts of water and in alcohol. Dose, $\frac{1}{24}$ to $\frac{1}{6}$ grain (0.0025 to 0.01 Gm.); average, $\frac{1}{2}$ grain (0.005 Gm.).

F. Unofficial Related Alkaloids.—Peronin (benzyl-morphine hydrochloride) $[C_{17}H_{18}(C_6H_5)CH_2NO_3.HCl]$, occurring as a white, odorless powder, soluble in water and diluted alcohol. Dose, $\frac{1}{6}$ to $\frac{2}{3}$ grain (0.01 to 0.04 Gm.).

Papaverine hydrochloride $[C_{20}H_{21}NO_4.HCl]$, occurring in colorless crystals or as a white crystalline powder, soluble in water. Dose, for children, $\frac{1}{12}$ to $\frac{1}{3}$ grain (0.005 to 0.02 Gm.).

Narcotine hydrochloride $[C_{22}H_{23}NO_7.HCl]$, occurring as a white powder, soluble in water. Dose, $1\frac{1}{2}$ to 3 grains (0.1 to 0.2 Gm.).

Apocodeine hydrochloride $[C_{18}H_{19}NO_2.HCl]$, occurring as a yellowish-gray to greenish-gray hygroscopic powder, soluble in water. Dose, $\frac{1}{3}$ to 1 grain (0.02 to 0.06 Gm.).

Pantopon (omnupon), a mixture of the total alkaloids of opium, soluble in water and suitable for hypodermic injection. Dose, $\frac{1}{4}$ to $\frac{3}{4}$ grain (0.015 to 0.05 Gm.).

Report of results obtained with narcophine, which was given in 15, 20, or 30 drops of a 3 per cent. solution internally; subcutaneously, 1 c.c. (16 minims) was used. Sleep was quiet, long, and refreshing. The effect upon digestion was evident and consisted in diminution of peristalsis. Zehbe (Munch. med. Woch., July 9, 1912).

Codeonal is a hypnotic containing in each tablet 0.02 Gm. ($\frac{1}{2}$ grain) of codeine diethylbarbiturate and 0.15 Gm. ($2\frac{1}{2}$ grains) of sodium diethylbarbiturate. The doses used consisted of 2, 3, or 4 tablets after the evening meal. In psychosis and neuropsychosis combined with general unrest and in the severely excited the remedy did not suffice as a sedative. On the other hand, it was very useful in patients with general **nervous excitement** or **exhaustion** of a milder nature, as well as in **organic nerve affections associated with pain**. In these it is a valuable substitute for veronal. It is also indicated in **insomnia where there is distressing dyspnea or cough**. Lena (Med. Klinik, June 8, 1913).

Narcophine, the meconate of morphine-narcotine, containing about one-third its weight of morphine, has certain advantages not possessed by morphine. It does not influence respiration, rarely causes vomiting, and has a more lasting action than morphine. The dose, 0.03 Gm. ($\frac{1}{2}$ grain), the amount contained in the ampules on the market, is not sufficient for all conditions, as, for instance, in the severe pain of **renal or gall-stone colic**. In such cases the writer uses $1\frac{1}{2}$ to 2 ampules; that is 0.045 to 0.06 Gm. ($\frac{3}{4}$ to 1 grain) of narcophine. Narcophine produces its effects less quickly than morphine, bringing about a gradual quieting of the patient, which, however, lasts much longer than after a hypodermic of pure morphine. After the immediate effects of $1\frac{1}{2}$ to 2 ampules of narcophine have worn off, there is less of a feeling of dullness and lassitude. S. Hirsch (Deut. med. Woch., Nu. 14, 1914).

The most important advantages of pantopon are, solubility in water, and the fact that the presence of the by-alkaloids of opium renders the preparation less active on the respiratory center. To get its full action on peristalsis, it must be given on an empty stomach. When it is given by mouth for **cough**, constipation can be obviated by suitable distribution of small doses and avoiding giving them on an empty stomach. After injections for hypnotic or analgesic effects, the constipating action is absent. Yet, **diarrhea** is easily controlled by its subcutaneous injection. H. Sahli (Brit. Med. Jour., Aug. 22, 1914).

Larger doses of codeine than are customary are deemed essential by the writer for securing satisfactory effects. In several hundred cases he gave the following amounts: $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.002 to 0.003 Gm.) in children below 6 months; $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.004 to 0.006 Gm.) in the second 6 months; $\frac{1}{4}$ to $\frac{3}{8}$ grain (0.006 to 0.01 Gm.) in the second year; $\frac{1}{4}$ grain (0.014 Gm.) in the fifth year, and $\frac{1}{2}$ grain (0.02 Gm.) in the tenth year. Such a dose is preferably given at night, undivided. W. Salomon (Deut. med. Woch., Dec. 1, 1922).

MODES OF ADMINISTRATION.—Opium may be satisfactorily administered either in fluid or solid preparations, generally by mouth. Where relief of only moderately severe pain is required, small doses of tincture of opium may be used with success. In severe pain, on the other hand, hypodermic injection of morphine is instead advisable, a much more prompt effect being produced, with relatively less influence in arresting intestinal activity and impairing appetite. Where diaphoresis is the end in view, Dover's powder, or some other combination of opium with ipecacuanha, is generally given preference. For astringent effects, opium should be administered in small doses in the form of the cam-

phorated tincture (paregoric), or in conjunction with chalk or one of the true astringent drugs. If a prolonged sedative as well as astringent effect on the bowel or stomach is to be procured, opium pills are particularly suited, not being dissolved and absorbed as rapidly as the fluid preparations of the drug. Suppositories of opium and belladonna may be advantageously used in dysentery and irritative diseases of the rectum. Where, on the other hand, a hypnotic effect is demanded, opium may be advantageously given with other soporific drugs, such as chloral hydrate, veronal, or trional, its unpleasant by-effects being therefore reduced owing to the relative smallness of the dose employed. In general, opium or morphine, used by mouth, should be taken some time after meals.

INCOMPATIBILITIES.—Precipitation occurs in fluid opium preparations upon the addition of salts of lead, mercury, iron, copper, and zinc, an insoluble meconate being formed. Alkalies, alkaline carbonates, and lime-water precipitate the alkaloids in opium preparations, and the same is true of tannic acid and drugs containing it, such as kino and nutgall. Cinchona is incompatible with opium. The presence of a small proportion of glucose in opium renders it incompatible with silver nitrate; pills containing these two agents in combination may explode.

Incompatible with morphine salts in solution are lead, mercury, silver, and iron salts; iodine and bromides; iodides; alkalies; magnesium oxide; potassium permanganate; sodium borate; spirit of nitrous ether; Fowler's solution, and tannic acid or drugs containing it.

CONTRAINDICATIONS.—Opium and morphine are absolutely contraindicated in acute dilatation of the stom-

ach or intestines, and in conditions associated with marked respiratory impairment, such as edema of the lungs or extensive pneumonic consolidation, or with Cheyne-Stokes breathing. In infancy and in old age they—opium, especially—should be employed with unusual caution and in reduced dosage; likewise in renal disease, particularly if a tendency to uremia exists at the time.

In children, opium may be given with the following precautions: Give very small doses frequently, and state, in both the written and the verbal directions, that the child must never be awakened to take its medicine. An overdose is thus impossible. The drug is of great value to timid, highly strung children, especially in the form of small doses of Dover's powder in feverish conditions. H. S. Sandifer (Pract., May, 1907).

PHYSIOLOGICAL ACTION.—

The action of morphine is practically identical with that of opium, except in a few minor respects, and may therefore be described as representing that of the whole drug. The morphine in opium, by virtue of its greater amount as well as potency, acts about 100 times as strongly as the codeine.

Locally, morphine exerts little or no action, though if it is applied to abraded skin areas, or to mucous membranes, a slight dulling of local sensation may be noticed.

Systemic Effects.—*Nervous System.*—Morphine is a depressant to the brain, acting especially on the so-called "perception centers," whereby sensory impulses of various kinds are taken up and translated into consciousness. The reaction time to sensory stimuli is increased, and the sensitiveness to pain and other disagreeable sensations, such as fatigue, hunger, and breathlessness, blunted or abrogated. Anxiety and

nervousness are lessened and, in sufficient dosage, a powerful hypnotic effect produced. While in the ordinary subject no stage of exhilaration precedes the induction of sleep, in the habitué the imaginative powers and animal propensities are for a time enhanced before hypnosis appears. Voluntary motor activity is, in the unhabituated subject, depressed by morphine, owing to the reduced perception of stimuli. When the subject is aroused, however, the motor incapacity typical of alcoholic intoxication is manifestly not present, the patient being able to use his extremities, as well as to think and speak clearly. While a sudden, strong stimulus will arouse the morphinized patient nearly as quickly as a normal subject, slight stimuli or continuous stimuli (including persistent pain) fail completely to prevent or disturb his sleep. In some subjects, especially of the female sex or belonging to southern Asiatic races, excitement is produced by morphine instead of depression. Massive amounts of morphine or opium produce coma.

On the spinal cord morphine has but little depressant action in man, while in many other mammals a marked exciting influence is exerted by it. The medullary centers, on the other hand, are strongly affected by it in man, the respiratory, cough, secretory, and temperature-regulating centers losing their sensitiveness, while the vasoconstrictor and vagus centers are stimulated.

The combination of morphine with the other alkaloids of opium does not reduce, but rather enhances the narcotic effect of morphine upon the sensory centers in the cerebrum. The paralytic effect of morphine upon the respiratory center can be combated by the synchronous, stimulating effect of other alkaloids, notably

by thebaine, which in this respect acts like strychnine. The opposite holds true for the vomiting center, which is stimulated by morphine and depressed by the other alkaloids. Narcotine, narceine, and papaverine, either alone or in combination, have no effect upon the tonus of the stomach. E. S. Faust (Münch. med. Woch., Nov. 12, 1912).

Circulation.—Here the effects are, in general, not marked. Small doses may at first slightly stimulate the heart muscle (Sollmann). The vagus and vasoconstrictor centers being likewise stimulated by moderate doses, some slowing of the heart, unaccompanied by a lowering of blood-pressure because of the compensatory vasoconstriction, may be noted. Such doses tend also to relax the superficial blood-vessels, causing increased warmth and redness of the skin. Poisonous doses of morphine finally depress the circulatory system in its entirety.

In rabbits, dogs and human subjects, morphine caused a slight leukopenia lasting an hour, followed by a more pronounced leukocytosis for 10 hours or more. There was a large relative, and also an absolute, increase of the polynuclears. In estimating the diagnostic value of a leukocyte count after morphine has been given, allowance should be made for these effects of the drug. Leake (Jour. Amer. Med. Assoc., June 3, 1922).

Respiration.—Morphine is a strong depressant to the respiratory centers in the medulla, even moderate doses causing a noticeable drop in the rate of breathing, while toxic doses may lower the rate to three or four per minute. The respirations not infrequently become irregular under morphine, sometimes assuming the Cheyne-Stokes type. The sensitiveness of the respiratory centers to carbon dioxide in the blood is lowered. Death, where caused by

morphine, is generally the result of total paralysis of these centers by the drug, with consequent cessation of breathing and asphyxia. Cough is relieved by morphine through depression of the sensitiveness of the centers concerned, these centers consequently losing the capacity to respond to irritation in the bronchi.

Secretions.—Morphine diminishes the activity of all the glands except the sweat-glands, which may secrete more sweat, owing, in part, at least, to the relaxation of the skin vessels. The urinary excretion may be diminished in nephritis, but in normal subjects shows no significant change.

Alimentary Tract.—Morphine greatly lessens motor and secretory activity, both in the stomach and intestines. At the same time a tendency to tonic spasm of the pyloric sphincter is manifest, the food in the stomach being so much more digested than usual that constipation is favored. In the remaining portions of the stomach tonicity is impaired. The powerful restrictive influence on intestinal peristalsis is believed due mainly to depression of the local nerve-centers (Auerbach's plexus) in the bowel walls, as severing connections with the central nervous system fails to prevent the effect.

Report of an X-ray research on the effect of opium on the intestinal tract. Its greatest influence was on the large intestine, the food remaining in the intestine from 24 to 33 hours. The effect on the small intestine was also considerable, its action being delayed from 5 to 8 hours. The action on the stomach was more inconstant. The motility was not markedly decreased except in one case. The peristaltic motion was first stimulated and then depressed. The sphincter of the pylorus was contracted. Opium seemed to have a

more intense effect on the intestine when used in conjunction with castor oil. Mahlo (Deut. Archiv f. klin. Med., cx, Nos. 5-6, 1913).

Morphine alone is more nauseating than when given with other opium alkaloids. Even minute doses, insufficient for the relief of pain, may produce nausea. Hence it is not logical to decrease the dose of morphine to eliminate its nauseating effect. Absorption from the stomach is not apparently interfered with by morphine or opium. The secretions of the stomach are, however, markedly decreased. Morphine, after having been absorbed from the intestines, is re-excreted by the gastric mucosa. This suggests lavage as a rational measure in poisoning. The most striking effect of morphine on the stomach is the powerful tonic contraction of the pylorus, which lasts for many hours. Opium, or the total opium alkaloids, does not or do not produce such a powerful pyloric spasm. The decrease in secretion and the pylorospasm are in large measure responsible for the indigestion following the use of morphine. Macht (Amer. Jour. Med. Sciences, Dec., 1917).

Gastric acidity is generally increased by opium. It raised the acidity to normal even in cases of pronounced hypoacidity, though failing to do so in anacidity. Independently of the conditions as to acidity, the evacuation of the stomach was primarily lengthened by opium. The pylorus is closed by the alkaloids of opium even though a condition of anacidity is present, for the retarded motility associated with increased tonus and active peristalsis would be otherwise unaccountable. Jarno and Marko (Wien. klin. Woch., Oct. 13, 1921).

Eyes.—Besides impairing the sense of sight, morphine in full doses causes pronounced contraction of the pupils. Since mere instillations of morphine do not produce this, the myotic action is believed to be of central origin; the drug, according to available evidence,

stimulates the oculomotor pupil-constricting center.

Bladder.—Abolition of the micturition reflex, with or without spasm of the sphincter, may occur in morphine or opium poisoning, with resulting retention of urine.

Metabolism.—Morphine lowers the basal metabolism, sometimes by as much as 25 per cent., soon after an injection. After repeated doses, however, this effect is no longer observed. Paradoxically, according to Sollmann, while CO₂ production is decreased by morphine, oxygen consumption is unchanged. The urine frequently contains reducing substances after morphine—partly morphine-glycuronic acid and partly glucose from the asphyxial tendency. The acidosis attending an initial dose of morphine is not found in persons partially accustomed to it.

Temperature.—The superficial temperature may at first be raised, even by small doses, owing to the dilatation of the peripheral blood-vessels. The internal temperature, on the other hand, is generally reduced by morphine, chiefly owing to the decrease in heat production attending bodily quiet and muscular inactivity.

Absorption and Elimination.—Morphine is rapidly absorbed through the mucous membranes, including those of the alimentary tract. When administered under the skin, morphine has been held to be rapidly excreted into the stomach to the extent of nearly one-half the amount taken. It has been said that about one-third of the morphine taken may be recovered from the feces. According to the investigations of Hatcher and Davis (1925), however, the view that morphine is re-excreted into the stomach is incorrect. Small amounts of the alkaloid are excreted with the

urine, sweat, and mammary secretion, and the remainder apparently undergoes oxidation in the system.

ACTION OF RELATED ALKALOIDS.—Codeine is much weaker as a brain depressant than morphine, and causes sleep or allays pain only in relatively large doses. It is advantageous, however, in being less depressing to the respiration—though a good cough sedative,—less constipating, and is much safer as regards habit formation upon repeated use. The dose of codeine required to allay cough has been at least six times as large, in Bastedo's experience, as that of morphine. Where pain is to be relieved, still larger amounts, *c.g.*, ½ grain (0.03 Gm.) every four hours, must be used.

Stimulation of the spinal cord is a distinguishing property of codeine as compared with morphine. Where a dose larger than the precise amount required to produce sleep is given, the tendency to spinal excitation appears in disturbed sleep and restlessness, together with exaggerated reflexes. If the drug be given in full doses to children, spasmodic movements may even be witnessed. Codeine is excreted mainly in the urine.

Heroin, or diacetylmorphine, acts in most respects like morphine, though effective in a smaller dosage. Thus, according to Higgins and Means, the action of 0.005 Gm. (1/12 grain) of diacetylmorphine on the respiration in man is nearly identical with that of 0.015 Gm. (1/4 grain) of morphine. Sollmann regards it, in common with the other morphine derivatives, as less effective in relieving dyspnea than morphine, which has more power to raise the carbon dioxide threshold. Diacetylmorphine has been stated to be less strongly hypnotic and anal-

gesic than morphine, but such a difference, if it exists, appears to be slight. Bastedo, however, found codeine more effective than heroine in allaying cough and pain and promoting sleep in tuberculosis. The effects of diacetylmorphine on gastrointestinal peristalsis and secretion seem to be somewhat less pronounced than those of morphine. Habit formation is as easy with heroine as with morphine. The prevailing opinion is that heroine presents no distinct therapeutic advantage over morphine for any purpose, while more toxic and irregular in action. The manufacture and importation of diacetylmorphine in the United States has been prohibited, and the drug was omitted from U. S. P. X (1926).

Heroine should be abolished by all nations. It is the drug used by addicts of over 95 per cent. of New York's underworld. All its useful qualities can be safely replaced by other alkaloids of opium. S. D. Hubbard (N. Y. State Jour. of Med., Feb. 1, 1924).

Dionin, in most of its effects, resembles codeine, and may be employed for the relief of cough or mild pain in doses of $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.). In addition it exhibits analgesic and lymphagogue properties when dropped in the eye. A 2 per cent. solution, thus used, produces a burning sensation, followed by pronounced edema and swelling, which begins to subside in about twenty minutes. Simultaneously a deep-seated analgesic effect is manifest, which persists for several hours and is utilized for the relief of pain in iritis, glaucoma, etc. Habit formation occurs much less easily with dionin than with morphine.

Dionin in a 1 to 2 per cent. solution is efficacious in relieving the soreness

and discomfort of the eye so often present in neurotics, apart from any demonstrable disease of the eyes. The author has found it useful in the pain of eye-strain. Hinshelwood (Interstate Med. Jour., Jan., 1907).

Dionin is an invaluable drug to promote absorption of exudates in **subacute and chronic processes of the cornea and iris**. In the more concentrated solutions good results are seen in **scrofulous ulcers and torpid infiltrations of the cornea**, especially in infancy. The drug is not indicated in episcleritis and in processes with deep or extensive injection of the vessels, or during the acute stage. Absorption is hastened after extractions and discissions. Septic processes after operations and trauma may be favorably affected by dionin and alcohol dressings. A good combination in **corneal opacities** is dionin with precipitate ointment, moist heat, and subcutaneous injections of fibrolysin. In deep **corneal scars after parenchymatous keratitis** good results may thus be obtained, while **superficial maculae** will often clear up under yellow ointment in conjunction with 5 per cent. dionin. The action of miotics is considerably enhanced by the addition of dionin. The following is a good combination: Pilocarpine hydrochloride, 0.02 Gm.; eserine salicylate, 0.03 Gm.; dionin, 0.2 to 10 Gm. Zirm (Woch. f. Therap. u. Hyg. d. Aug., 37, 1910).

Peronin resembles codeine in its effects, and has been used as a respiratory sedative in **cough**. It possesses in addition, however, a depressant effect on the heart which renders its use less advisable than that of the other alkaloids mentioned.

Papaverine may be stated to stand midway between codeine and morphine in the quality of its action on the central nervous system, though it is relatively feeble, and does not cause profound sleep even in large amounts. According to Pal, papaverine depresses

the smooth muscle of the blood-vessels and viscera, and may be used with advantage in all conditions associated with **high blood-pressure**, as well as in **hemoptysis**; the sulphate of papaverine may be given subcutaneously for this purpose in the dose of $1\frac{1}{2}$ grains (0.1 Gm.) or intravenously in the dose of $\frac{3}{4}$ grain (0.05 Gm.).

Papaverine, reducing the tonus of smooth muscle fibers, is invaluable as an **aid to Röntgen diagnosis** in determining if an **atonic condition of the stomach** is due to pylorospasm, or to organic obstruction at the pylorus. An exposure is made after the patient has taken a barium sulphate suspension; then, after one day's rest, the patient receives 0.05 Gm. ($\frac{3}{4}$ grain) of papaverine hydrochloride by mouth, and a second exposure is made one hour later. Where, under the influence of the alkaloid, the delay in the emptying of the stomach was corrected, that is, the stomach again emptied itself in the normal time, the subsequent history and treatment of the cases showed that the disturbance depended upon a pylorospasm. Where the stomach emptied itself more slowly under the influence of papaverine than before, in each case an actual pyloric stenosis was found as lesion. By means of papaverine it is also possible to determine the spastic nature of an hour-glass stomach. S. Szerb and V. Revesz (Klin.-therap. Woch., March 2, 1914).

Narcotine is much less toxic than either morphine or codeine and, while resembling the latter in its effects, exerts an even greater excitant action on the spinal cord. Its own narcotic properties are very weak, but it has been shown to reinforce the action of morphine when administered with it.

Apocodeine promotes intestinal peristalsis by depressing the endings of the sympathetic or inhibitory nerve-supply to the bowel walls, and may be used

clinically for this purpose in hypodermic doses of $\frac{1}{2}$ grain (0.03 Gm.). By paralyzing sympathetic endings in general it antagonizes or prevents the actions of epinephrin (adrenalin), including that on the vessels. It has been used as an expectorant and sedative in **chronic bronchitis** and other bronchial affections.

ACUTE POISONING.—Acute poisoning by opium or morphine may occur by intent or accident, through an overdose of one of the official preparations, but not infrequently takes place through the careless use of certain proprietary medicines. Children, being very susceptible to the action of opium, are at times profoundly affected by seemingly small and appropriate doses. Soothing syrups and carminatives containing opium have contributed their share in increasing infant mortality. Idiosyncrasy, in the adult, will sometimes cause profound effects to follow the administration of a moderate dose of this drug. Among the more common unpleasant accompaniments of morphine or opium action are nausea, with or without vomiting, and itching of the skin. After-effects, such as headache, mental depression, constipation, nausea, and imperfect digestion due to impairment of gastric secretions are very frequent. Repeated use of morphine for several days may induce persistent vomiting. Occasionally a roseolar or mottled rash, with or without fever, is noted. Bastedo has reported instances of partial heart-block, suspension of breathing in tabes dorsalis, and edema of the lungs in chronic cardiac and acute pulmonary cases, as a result of administration of these drugs. At times diarrhea is

noted. In a few individuals, especially nervous women, morphine causes excitement instead of depression. Cases of idiosyncrasy to codeine with peripheral hyperemia and collapse symptoms resulting from the use of moderate doses of this alkaloid have also been reported. Many of the untoward effects of opiates can be prevented by simultaneous administration of **nitroglycerin** or **potassium bromide**.

An urticarial wheal with surrounding erythema, quite like that formed by local inoculation of foreign protein in susceptible subjects, is produced by solutions of morphine and its esters when introduced into the skin. A minimum concentration of 1:1,000,000 of morphine was effective in about $\frac{1}{2}$ the experiments; a 1:100,000 solution always produced the wheal and congested area. The reaction reached its height in 5 to 15 minutes and disappeared in 1 to 2 hours. The reaction being the same in addicts as in normal individuals, systemic tolerance of morphine evidently does not induce local (skin) tolerance. Edema lessens or abolishes the wheal formation. Pilcher and Sollmann (*Arch. of Int. Med.*, Apr., 1924).

A poisonous dose of opium or one of its preparations is followed by a well-defined train of symptoms. There may be noticed first a preliminary stage of mental excitement, which is accompanied by a feeling of well-being and content and an acceleration of the heart's action. This is soon followed by headache, weariness, a sensation of weight in the limbs, and drowsiness. With these feelings are observed a diminished sensibility of the skin, contracted pupils, deeper and slower respiration (sometimes not more than eight to ten to the minute); slow, full pulse;

suffused or even cyanotic face, and warm, dry skin. The breathing may now become puffing and stertorous. In this stage the person may be aroused by being loudly called or violently shaken, but, if left alone, he falls asleep at once. When the patient is aroused the respirations become more frequent, the blood better aerated, and the duskiness of the face disappears. Death seldom, if ever, occurs in this stage from the action of the poison alone, but death may take place if a complicating disease be present.

If the dose taken be a lethal one, the symptoms increase in severity. The face becomes at first more cyanotic, then, as death approaches, pale and livid. The pupils contract to the size of a pin's point. The respirations now drop to 4 or 5 per minute, and become irregular and shallow. The pulse becomes weak and compressible; the skin cold and covered with a clammy perspiration. There is complete muscular relaxation; the lower jaw drops. The reflexes are abolished. The patient cannot now be aroused. Death occurs by respiratory paralysis, though at times the heart ceases its action almost simultaneously. Dilatation of the pupils is found only after or shortly before death.

Death, in the adult, has followed the ingestion of $2\frac{1}{2}$ grains (0.15 Gm.) of extract of opium, 4 grains (0.25 Gm.) of powdered opium, 1 grain (0.06 Gm.) of morphine, and 1 fluidram (4 c.c.) of tincture of opium. Taylor reports the death of a child 4 weeks of age after taking $2\frac{1}{2}$ minims (0.15 c.c.) of paregoric. The amount that can be taken without producing death by those habitu-

ated to the use of the drug is almost incredible. (For the symptoms and treatment of chronic poisoning by opium, see the section on MORPHINOMANIA at the close of this article.)

Case of severe poisoning following the injection of $\frac{1}{2}$ grain (0.03 Gm.) of heroine, a short time after an operation for chronic appendicitis. The symptoms appeared within ten minutes, the patient having the appearance of a person profoundly under the influence of an opiate. After about an hour the respiration was brought up to about 10 to the minute, but during that hour it had been very irregular, going from 4 to 8 a minute, and back to 4. The pupils were contracted to pinpoints during this time. The patient recovered. Trawick (Ky. Med. Jour., Feb. 15, 1911).

Case of a 3-month-old child whose father gave to it by mistake about 0.02 Gm. ($\frac{1}{3}$ grain) of morphine. The child went to sleep at once. An hour after, the mother became alarmed and sought aid. The stomach was washed out at once and other measures employed. Sixteen hours after the ingestion of the morphine the child was in a fairly good condition. Thus the usually assumed intolerance in infants for morphine does not always hold. This child was given more than 20 times the dose for an infant of its age. Wichura (Münch. med. Woch., July 25, 1911).

Diagnosis of Acute Opium or Morphine Poisoning.—Some cases of acute poisoning by opium bear a close resemblance to cases of uremic coma, alcohol intoxication, and cerebral apoplexy (especially hemorrhage into the pons Varolii). In all these conditions there may be coma, stertorous breathing, slow respiration and pulse, and congestion of the face. The history of the case may or may not be of assistance. In *uremic coma* there is generally more

or less edema present, and convulsions may be noted. The pupils are usually normal or dilated. The presence of albumin and casts would point to uremia, but albumin may be present in the urine after an apoplectic seizure or an intracranial hemorrhage, even though the kidneys have been in a healthy condition prior to the attack. *Alcoholic intoxication* may be suspected from the odor of spirits or of ethers on the breath or about the person. In alcoholic intoxication the patient can be roused and will answer questions. The pupils may be contracted in acute alcoholism, but will dilate when the patient is aroused. The breathing is not as slow as in opium poisoning. A hypodermic injection of apomorphine will cause a man unconscious from alcohol to vomit, but will have no effect in opium poisoning. The possibility of double poisoning by opium and alcohol should be borne in mind. In cerebral *apoplexy*, except where hemorrhage has invaded the pons Varolii, the pupils are not contracted or are unsymmetrical; there is strabismus, sometimes facial asymmetry, usually paralysis of one limb or both, and some difference in the reflexes of the two sides of the body. In apoplexy the onset of the symptoms is sudden, there is often no history of having taken food or medicine, and the face, although congested or pale, is not swelled and cyanosed as in opium narcosis. *Hemorrhage into the pons* is rare and generally fatal; the attack is sudden and the entire body is relaxed, with involuntary evacuations of bladder and bowel, which is not usual in opium poisoning. In the coma following an *epileptic convulsion* the tongue will probably be bit-

ten, the pupils dilated, and the respirations but little slower than normal. The occurrence of a convulsion at the beginning of a disturbance excludes opium poisoning.

Treatment of Acute Opium or Morphine Poisoning.—In the mildest form of opium poisoning, characterized by lethargy, partially contracted pupils, and slow respiration and heart action, the administration of **strong coffee** by mouth or rectum, with an ample supply of **fresh air**, is likely to suffice. **Stomach washing** may be instituted to lessen nausea and remove some of the toxic agent.

In the more severe cases, the first indication is to empty and wash out the stomach. **Emetics**, such as **zinc sulphate** and **mustard**—or in children, **ippecac**—may be used, but large doses will be required, and the **stomach-tube** is preferable if it can be used. By means of it antidotes can be introduced into the stomach as soon as it is washed out. **Potassium** (or **sodium**) **permanganate** and **tannic acid** are the best chemical antidotes, and a solution of one of these—preferably the former—should be placed within the stomach by means of the stomach-tube, or ingested immediately if stomach washing cannot be at once resorted to. The permanganate, if given while the poison is still in the stomach, will decompose it. A quantity of the permanganate at least equal to the amount of morphine swallowed should be administered, well diluted with water, as recommended by William Moor, who first suggested the use of this valuable measure. Subsequently the stomach should be washed out at intervals of 15 to 30 minutes with water or, preferably, a 1:1000 or 1:2000

permanganate solution. Each time some of the solution should be left in the stomach after it has been washed out, to decompose any morphine that is eliminated into this organ. Where gastric lavage is not practicable, emesis will be assisted by having the patient take large amounts of **warm water**. Another eliminatory measure recommended is **colonic irrigation**, to remove the morphine as it is excreted into the bowel, and thus avoid its reabsorption into the system. Gilbert had success in the case of a 1-year-old child, given by mistake a teaspoonful of wine of opium, by administering as much **milk** as the child could take, followed by a tablespoonful of syrup of **ippecac**; the opium seemingly was imprisoned by the milk-clots and then removed by the emetic.

An important measure in opium or morphine poisoning is to **keep the patient awake and moving**, as this assists materially in maintaining the respiration. The heart usually being in fair condition during most of the course of the poisoning, the **patient** may be **walked up and down**, this causing increased carbon-dioxide production, with consequent stimulation of the respiratory centers. **Slapping the chest with a wet towel**, **alternate affusions of hot and ice-cold water to the nape of the neck**, **shouting in the patient's ear**, **counterirritation**, **electric shocks** or the **electric brush**, etc., are other useful procedures calculated to maintain the activity of the vital centers through vigorous peripheral stimulation. One need not hesitate to inflict considerable pain in keeping the patient awake. **Tickling the patient** is recommended by Lyne as a more efficient and less cruel measure

than flagellation; in his experience it acted remarkably, not only in wakening the patient, but angering him nearly to the point of fighting.

Respiratory activity may also be excited by the use of stimulants such as **hot, strong coffee**, given hourly by rectum, mouth, or stomach-tube, in large amounts, **caffeine** hypodermically (10 grains—0.6 Gm.—of caffeine sodiobenzoate at a dose), **atropine sulphate** ($\frac{1}{40}$ grain—0.0015 Gm.—in one or divided doses), **strychnine sulphate** or **nitrate** ($\frac{1}{30}$ to $\frac{1}{15}$ grain—0.002 to 0.004 Gm.—at a dose), and, as recommended by Petzey, **cocaine hydrochloride** ($\frac{1}{2}$ to 1 grain—0.03 to 0.06 Gm.—at a dose). **Ammonia** preparations may also be employed for purposes of rapid reflex stimulation. According to Cummings, coma in morphine poisoning is quickly overcome by the introduction of ice into the rectum.

Artificial respiration is of extreme importance in severe cases when the respiratory rate has dropped to 3 to 5 per minute and failure of this function is imminent. This measure should be kept up for long periods, or until the rate has risen to 8 or 10 per minute, and often saves life when persisted in. **Oxygen inhalations** may be used. Where the body temperature falls, **external heat** is indicated. **Catheterization** may be required, if there is retention of urine.

Case of opium poisoning in which the patient swallowed a solution containing about 30 grains (2 Gm.) of morphine acetate, and was not discovered until 3 hours later. In spite of **washing out the stomach**, injections of various **stimulants**, and **faradism**, cyanosis became profound, and death seemed imminent. **Oxygen** was then given and **artificial respira-**

tion commenced: 6 hours later there was a slight attempt at respiration, and at the expiration of 2 hours more artificial respiration was temporarily discontinued; 18 hours after the ingestion of the poison the patient was practically out of danger, and she ultimately recovered. D. T. Playfair (Lancet, Aug. 27, 1898).

Case of accidental administration of a fluidram (4 c.c.) of liquor morphinæ (B. P.) to a 3-month-old baby. Within 10 minutes the child was seized with violent tetanic convulsions and with periodic cessation of breathing. Pupils were contracted to pinpoint. Later the child was comatose. **Artificial respiration** was continued for 3 hours and occasionally for the succeeding 6 or 7. Within an hour the child was given $\frac{1}{300}$ grain (0.0002 Gm.) of **atropine**, subcutaneously; half an hour later, $\frac{1}{500}$ grain (0.0004 Gm.). Twice afterward $\frac{1}{300}$ grain (0.0002 Gm.) was administered. **Strong decoction of coffee and peptonized milk** were given by the rectum, and **fomentations** applied to the **epigastrium**. The **face**, the upper part of the **chest**, and the **other accessible parts** were **slapped with cold, wet towels**. The child opened its eyes at the end of 24 hours. Bronchopneumonia developed, from which recovery took place in 10 days. J. Fotheringham (Brit. Med. Jour., Oct. 22, 1898).

Case of the administration of $\frac{1}{8}$ grain (0.008 Gm.) of morphine to a baby 2½ days old, one of the tablets intended for the mother having been given. The pulse became poor in quality and rose in rate until it had reached 160. The respirations were irregular, varying between 6 and 60. The facies became more dusky, and there were periods of cyanosis of 5 to 10 minutes in duration.

The treatment consisted in the use of **wine of ipecac**, 15 minims (0.9 c.c.) and repeated doses of **atropine sulphate**, $\frac{1}{850}$ grain (0.00018 Gm.), subcutaneously; **strychnine sulphate**, $\frac{1}{240}$ grain (0.00027 Gm.); subcutaneously;

brandy, 3 to 30 minims (0.18 to 1.8 c.c.); **suds and glycerin enemas**; **black coffee**, 4 ounces (120 c.c.) by rectum; **castor oil**, 1 dram (4 c.c.). Next day there was profound cyanosis and apnea for 1 hour, during which **artificial respiration** and **oxygen** were constantly employed. Twenty-four hours after the ingestion of the drug, there was a response for the first time to external stimulation. There was a final attack of severe cyanosis some hours later, recovery following. N. R. Mason (Boston Med. and Surg. Jour., Feb. 9, 1911).

Two cases of acute opium poisoning in which recovery was due largely to prolonged use of the **faradic current**. Taylor (Lancet, April 27, 1912).

Adrenalin should replace atropine in the treatment of morphine poisoning. In tests on his own person and in others, the writer found atropine without effect on lung ventilation, while 0.0005 to 0.001 Gm. ($\frac{1}{30}$ to $\frac{1}{45}$ grain) of adrenalin hypodermically deepened the respiration appreciably in 2 to 4 minutes and doubled the lung ventilation in 6 to 10 minutes. While the effect soon declines, the breathing is still appreciably above normal $\frac{1}{2}$ to 2 hours after the injection. Adrenalin is effective even in doses of 1 drop of the 1:1000 solution. A. Bornstein (Deut. med. Woch., June 9, 1921).

Subcutaneous injections of a 1 per cent. solution of **potassium permanganate**, or intravenous infusions of a 0.1 per cent. solution in physiologic sodium chloride solution, advised. The morphine is rapidly oxidized. O. Moor (Deut. med. Woch., Oct. 24, 1924).

Case in which 3.6 Gm. (55½ grains) of morphine had been taken. The respiration was failing in spite of **atropine** and **stomach washing**, when 0.01 Gm. ($\frac{1}{60}$ grain) of **lobeline** was given intramuscularly. The breathing improved after 7 minutes, and two more injections were given at 10 minute intervals, with marked effect. Further injections were given $\frac{1}{2}$ to 1 hour apart, recovery following. Stern (Deut. med. Woch., Feb. 20, 1925).

THERAPEUTICS.—Opium and morphine are in widespread use for the relief of severe **pain**; to overcome **restlessness**, **apprehension**, or **insomnia** occurring in association with **severe illnesses**; to prevent the effects of **systemic strain** and **shock**, and to inhibit undue secretory activity.

To repeat all the indications of the various opiates (already submitted in the treatment of all diseases in which they are used) under this head would require about fifty pages, which the editor prefers to devote to other matter. Among the recognized uses of opium and morphine may be briefly mentioned the following: (1) To check **hacking cough**, as in **acute** or **sub-acute bronchitis** and **pulmonary tuberculosis**. (2) To arrest **diarrhea**, where evacuation of the bowels, starvation, and remedies such as bismuth, astringents, and intestinal antiseptics have failed, as well as in **dysenteric conditions**. (3) To control **spasm**, especially of involuntary muscle-tissue, as in **dysentery**, **renal** and **hepatic colic**, **lead poisoning** with spastic constipation, and **bronchial asthma**. (4) To arrest **vomiting** by depressing the medullary emetic center. (5) To check **intestinal peristalsis**, as after abdominal or rectal operations, and in **intestinal hemorrhage** and **peritonitis** after the diagnosis has been made. (6) To induce sweating and alter the distribution of blood by displacement to the periphery, as at the onset of an **acute coryza** or **bronchitis**. (7) To relieve **dyspnea** or **pain** and promote general quiet and peace of mind in **heart disease**, including **angina pectoris**. (8) To allay **restlessness** in **hemoptysis** and other severe forms of **hemorrhage**. (9) To prepare the way

for **general anesthesia** by ether or other similar agent. (10) To reduce sugar excretion in **diabetes mellitus**.

Further information on the uses of drugs of the opium group is afforded in the subjoined abstracts.

In cases of **weak heart** after exhausting disease, after prolonged mental and physical pain, and without organic lesion of valves or muscle, opium is of advantage. In the gradual engorgements from **myocardial dilatation**, in **chronic parenchymatous nephritis**, and in **arteriosclerosis**, it is also of value. If the patient is hypochondriacal or hypersensitive, the second daily dose of opium invites sleep and induces a feeling of well-being. The **dyspnea of myocarditis** is relieved or prevented by continuous small doses of morphine. The **tachycardia of Graves's disease** is relieved, and in 3 cases it appeared to contribute to the cure of the disease. J. H. Musser (Amer. Jour. Med. Sci., Jan., 1906).

In the early stages of **bronchitis**, and in **laryngitis**, so often **associated with influenza**, heroine may be used for relieving the constant irritating cough, and so inducing sleep.

℞ *Heroinæ hydrochloridi* gr. ⅓ (0.01 Gm.).
Acidi hydrocyanici diluti ℥ viij (0.5 c.c.).
Aquæ chloroformi
 q. s. ad ℥ij (60 c.c.).

A tablespoonful to be taken every hour until relieved will usually give good results, and will not cause any headache or nausea the following morning. A. Bousfield (Pract., May, 1907).

Some patients who cannot take internally a dose of morphine by itself without being nauseated will take it, combined with the aromatic spirit of ammonia, without any difficulty. In the **colicky attacks** and the **gastro-intestinal catarrh of children**, opium is best given *per rectum*, mixed with a little thin starch or arrowroot, in the form of ½ to 2 grains (0.03 to

0.12 Gm.) or more of Dover's powder or: the compound kino powder (B. P.), according to the age of the child. The opium in this form is absorbed slowly and there is no risk of rapid narcotism, as will sometimes occur when a fluid preparation is used.

In acute "streaming" **coryza**, the best combination consists of ¼ to ⅓ grain (0.016 to 0.02 Gm.) of morphine with 1 dram (4 c.c.) of nitrous ether, 3 drams (12 c.c.) of solution of acetate of ammonia, and 1½ ounces (45 c.c.) of camphor water. This should be taken at bedtime, after a very light dinner, at the very onset of the attack. In a quarter of an hour the secretions will cease, the respiration become free, the soreness and aching of the eyes disappear, and a comfortable night's rest be enjoyed. The patient should be confined to his room for a day or two, otherwise, on exposure to chill, his symptoms will return. As a small dose of morphine is, in many persons, followed by very light-colored stools, from defective secretion of bile, it is often advisable to combine with it some hepatic stimulant, such as a few grains of colocynth and blue pill.

In **chronic gastric catarrh**, with much pain and nausea, and in **gastric ulcer**, it is well to combine opium with bismuth and hydrocyanic acid; or it may be given (½ grain of the extract—0.03 Gm.) with silver nitrate (¼ to ½ grain—0.016 to 0.03 Gm.) an hour before food.

In attacks of **enteralgia** or **colic**, it is useful to give a few drops of tincture of opium with a tablespoonful of castor oil; or opium liniment may be rubbed into the abdominal surface with the warm hand.

In **persistent diarrhea in infancy** and **early childhood**, the dose of opium used must be very small, and carefully graduated to the age of the child; ½ to 1 grain (0.03 to 0.06 Gm.) of Dover's powder, or 1 to 3 grains (0.06 to 0.2 Gm.) of compound kino powder are suitable.

Small doses of codeine are of great use in some cases of **sleeplessness associated with advanced cardiac valvular lesions**.

In **acute laryngeal catarrh**, especially that form often connected with **influenza**, heroine appears to be quite as efficacious in quieting the cough as morphine, and to have the advantage of loosening the tenacious mucus.

A combination of opium and belladonna often answers well in **pulmonary tuberculosis** where **night-sweats** are brought on by coughing. In **troublesome diarrhea** in the same disease, a good plan is to give 5 to 10 grains (0.3 to 0.6 Gm.) of Dover's powder and 10 grains (0.6 Gm.) of tannic acid, mixed with 2 ounces (60 c.c.) of starch mucilage, as an enema twice daily. I. Burney Yeo (*Pract.*, May, 1907).

In **nocturnal dyspnea in cardiac decompensation**, morphine should be given hypodermically in sufficient doses to allow the patients to lie comfortably without elevation of the shoulders. The resulting absolute bodily rest is a prerequisite to the effectiveness of cardiac stimulants. Ordinarily 3 or 4 days are sufficient to get enough improvement of the heart to allow rest at night, without morphine. LeRoy Crummer (*Med. Herald*, Oct., 1908).

Opium has stimulating as well as sedative properties. The stimulating action is well seen in cases of **indolent ulcers** of the skin and mucous membrane. The pale, unhealthy-looking surface becomes red and is soon covered with closely set granulations, while its secretion changes from a thin serous fluid to healthy-looking pus. This invigorating influence can be turned to account in obstinate sores occurring in cachectic children. In the **ulcerative stomatitis** common among ill-fed and badly nourished children of the very poor, which often shows little disposition to heal even when treatment is reinforced by a generous diet and healthy surroundings, a few drops (2 to 5) of laudanum, given twice a

day, quickly start an improvement which goes on smoothly to a cure.

The nervous trepidation called "**stage fright**" may be forestalled and disarmed by a small dose, 5 or 6 drops, of laudanum taken half an hour or so before the trial is to begin. The same treatment goes far to relieve the **distress of dying** persons. In inflammation of the serous membranes morphine must be freely given. It may be given to infants. For a child of 12 months $\frac{1}{40}$ grain (0.0016 Gm.) morphine may be injected, combined with $\frac{1}{400}$ grain (0.00065 Gm.) atropine in cases of **spasm**, and in half an hour the dose may be repeated if the spasm is not relaxed. E. Smith (*Brit. Med. Jour.*, Dec. 4, 1909).

Dyspnea attended by insufficient expectoration contraindicates opium, unless expectoration is simultaneously facilitated by inhalations of steam, or of chloride of ammonium evaporated by dry heat, or by the internal use of ipecac, camphor, or benzoic acid. The stimulating effect of opium makes it a welcome remedy in the large number of **myocardial affections** which have become so frequent in **influenza**, **diphtheria** and other **infectious diseases**. A child of 5 years thus affected will readily and profitably take 4 daily doses of codeine, $\frac{1}{20}$ or $\frac{1}{16}$ grain (0.003 or 0.004 Gm.), more or less, through an indefinite period. Many a case of **chorea**, mainly such as are connected with endocarditis, bear and require codeine in a similar way.

Catarrhal diarrhea, **follicular enteritis**, and **dysentery** indicate opium. A baby of 1 year or less requires an average dose of $\frac{1}{40}$ grain (0.0022 Gm.) of opium as a part of its medication, once every 2 hours. That dose may be taken a long time. Dysentery requires more; particularly, if the drug is used locally, in an enema or a suppository. Tenesmus may demand the local application of larger doses. A. Jacobi (*Therap. Med.*, Jan., 1910).

Morphine in **advanced heart disease** tranquilizes the patient, regu-

lates the heart action, and may even show a curative tendency. In 1 of the 5 extreme cases reported by the author, large doses of morphine kept up for 23 months restored the patient to a comparatively active life. He received daily from 0.02 to 0.09 Gm. ($\frac{1}{3}$ to $1\frac{1}{2}$ grains) of morphine during the first 6 months, then from 0.12 to 0.34 Gm. (2 to 5 grains) daily for a year with progressive large doses of chloral. The doses were reduced gradually to *nil* in the course of 5 months, and the patient discharged in fairly good condition. Siebert (Med. Klinik, June 28, 1912).

In diseases of the ciliary region and iris dionin is definitely curative. A weak solution (2 per cent.) should be employed at first, but later stronger solutions (8 to 10 per cent.) may be prescribed, or even a little dionin in powder form applied to the conjunctiva, or a 10 per cent. solution injected subconjunctivally. An interval of 36 hours should be allowed between instillations. Only one condition—spring catarrh—seems to be worse after its use. P. A. Harry (Prescriber, July, 1912).

To clear up vitreous opacities dionin is a valuable agent. Retinal hemorrhages are absorbed with great rapidity under its influence. In the opacities following parenchymatous keratitis, the relief is very prompt and certain; likewise in posterior synechia accompanying iritis. In recent pannus a cure may be expected, and even in old pannus a thinning is usually seen after a few weeks. In these cases the author begins treatment with an ointment of 10 per cent strength. Corneal ulcers healed promptly under exclusive use of the ointment. H. E. Goetz (Detroit Med. Jour., Sept., 1912).

Systematic use of opium after certain laparotomies is favored by the writer. Beginning 4 hours after the pre-operative dose, he gives opium or morphine hypodermically, $\frac{1}{4}$ grain (0.015 Gm.) every 4 hours, day and night, for 3 to 5 days. In 30 per cent. of 50 laparotomies for, *e.g.*, fecal

fistula, ruptured appendix, pelvic abscess, intestinal anastomosis, resections, hysterectomy, ventral hernia, etc., the bowels moved with expulsion of gas without a physic on or before the 3d day. In 22 per cent. there was some nausea after the 1st day. There was no pain nor hiccough. Morphine after operation promotes recovery by removing the causes of sleeplessness, thus preserving energy and favoring regeneration. A. W. Collins (Cal. and West. Med., June, 1924).

When 2 to 4 c.c. (32 to 64 minims) of a 25 per cent. solution of C. P. magnesium sulphate solution are injected with morphine, the value of the latter is increased from 50 to 100 per cent. Clinical tests showed a prolongation of the average duration of relief from 4 hours 6 minutes after morphine alone to 16 hours 16 minutes with the magnesium salt. J. T. Gwathmey (Jour. Amer. Med. Assoc., Nov. 7, 1925).

MORPHINOMANIA AND OPIUM HABIT.

DEFINITION.—An irresistible craze for morphine, opium, or any of the preparations of these drugs. The term "morphinism" is applied to the symptom-complex resulting from the undue use of morphine.

SYMPTOMS.—The craving for opium or morphine is due sometimes to the pleasurable sensations it excites, whether this manifests itself in the relief of severe pain—the initial cause of many cases—or to exhilaration. In the latter case the symptoms, as described by Norman Kerr, are as follows: "A few minutes after the dose, with a shorter interval when given hypodermically, the face is suffused with a blush, with probably a well-defined hectic spot. The eyes sparkle with unwonted brilliancy. The countenance is ruddy and the expression animated. This is

the stage of excitement or exhilaration. The pulse beats faster and muscular activity is increased.

"This exhilaration gradually subsides into a sense of complete happiness, satisfaction, and repose, with a slower pulse rate and muscular quietude. This constitutes the second stage.

"A vacant look, with an occasional gleam of momentary consciousness, ushers in the third stage. The opiiized person gradually sinks into a state of torpor, from which he is with difficulty aroused. The only effectual means of arousing him is to administer a fresh dose of the narcotizing agent. The face looks pale or dusky, the skin is withered, and the pupils are contracted to the size of a pin's head.

"The vascular system is relaxed in the first stage and slightly tightened up in the second, this contraction being intensified in the third. The awakening from the third stage of torpor, prostration, and apparently impending death, is wretched. Tremors are succeeded by growing restlessness, and with returning consciousness there is an overwhelming sense of intolerable uneasiness, distress, and depression, which imperiously craves for a renewal of the bewitching soporific. In this state of reaction the agony, or desperation, is sometimes so acute that suicide or homicide has been the issue."

The intense craving is thus due, not only to pleasurable phenomena experienced, but also to the relief of the morbid effects of the drug. These undoubtedly cause keen suffering.

The deterioration of the central nervous system is such as to transform completely the victim. Losing all self-control, he becomes untruth-

ful and irresolute, and even dishonest to the point of swindling, this characteristic disappearing, in normal individuals, when the opium habit is cured.

Drug users are of 2 kinds: Those of education and of more or less stable make-up mentally and morally, who, through ignorance, accident, or disease, have acquired an uncontrollable need for the drug, and a second group, with conspicuous absence of these traits. Some 90 to 95 per cent. of the 4000 cases treated at the Philadelphia General Hospital in the last 8 or 10 years were of the second type. Among them were many instances of retarded mental growth, and physical examination showed frequently recurring stigmata of degeneration (12 per cent. of 493 cases). Drug addiction, as a symptom of a serious defect of character or lack of physical stamina, requires a readjustment of our views as to prognosis and treatment. This explains why most treated cases relapse. Treatment relieves a symptom only. Doane (*Therap. Gaz.*, Aug., 1924).

Mental depression, with a sense of impending evil, anxiety and restlessness become intense on withdrawal of the drug, and suicidal impulses have to be guarded against. In China, over 100,000 suicides yearly are due to opium. Anorexia, indigestion, constipation alternating with diarrhea, are usual; emaciation, a peculiar pallor or sallowness, the features appearing wizened and aged, give the patient a characteristic appearance.

When the habit is of long duration, neuralgic pains, tremors, paresis, and even ataxia may be witnessed. Such cases yield rapidly to acute diseases. Chronic dysentery, dyspeptic and neuralgic pain, a harassing cough, evanescent albuminuria during the exhibition of the drug, and also after its discontinuance have been noted.

Cirrhotic and nephritic disorders are infrequently seen with opium.

Morphine can be detected in the urine. The latter, in morphinomania, reduces sulphate of copper if heated with caustic soda, and gives, although slowly, an abundant precipitate of copper oxide, while polarization and fermentation give a negative result.

When smoked, opium is more quickly absorbed than when eaten, but it is less harmful, as only a comparatively limited quantity can be inhaled at a time. With the latter mode of use there is greater disorder of digestion. Opium drunk in a liquid form may be classed alongside opium taken as a solid. The speedier absorption of laudanum is more than counterbalanced by the smaller quantity that can be taken on account of the larger bulk. The hypodermic injection of morphine is, however, the most swift and the most potent of all the methods of administration. The effect is almost immediate.

No one can describe the torture experienced by opium inebriates on the failure of the supply of a fresh dose at the accustomed time. On receiving it, the patient will at once become lively, clear-headed and brilliant on the exhibition of a sufficient dose. This depraved physical state is a pathological condition—a physical depression which clamors for a renewal of the potion as soon as the pleasurable effects of the preceding dose have disappeared.

A common feature of all narcotic inebriety, according to Kerr, is the frequent perversion of the affections. Love is transformed into hate, and the narcomaniac not unseldom loathes the sight of the devoted companion whom, in his prenarcotic years, he

cherished with the tenderest affection. Opium transforms the manly, high-toned, pleasant companion into an effeminate, driveling, querulous bore.

DIAGNOSIS.—The opium slave is recognized by his glazed eye, hollow cheeks, wasted frame; dry, parchment-like skin; slothful habit, and livid countenance; the opiomaniac and morphinomaniac are often difficult of detection, if they have a supply of the drug about them. The pupil is not a reliable guide, since it is only contracted under the direct influence of the drug. Most of the time, particularly in advanced cases, it is dilated. Severe persistent pain in the epigastric region, yielding after a few days of abstinence, has been noted.

Symptoms suggesting malaria are occasionally seen, both during the presence and absence of the narcotic. There are high temperature and shivering, like the cold and hot stages of intermittent fever. There is also an opiate and morphine "trembling delirium," exclusive of the acute wakeful and trembling delirious state supervening on sudden withdrawal. The temperature is lowered in alcoholism, but is slightly raised by opium.

In the absence of withdrawal symptoms and puncture scars, the diagnosis of drug addiction is often impossible, and isolation under close observation is usually alone successful. J. C. Doane (*Mthly. Bull., Dept. of Publ. Health, Phila., Dec., 1922*).

In the diagnosis of morphine addiction, contracted pupils with weak response to light is of significance, though in 1 long-standing case seen the pupils were widely dilated. Abrupt changes from apathy to alertness are suspicious, as also an unaccountable emaciation. There is generally

a partial or complete loss of libido and potency, and sexual delinquencies are rare, with the possible exception of a homosexual proclivity. A. Wimmer (*Ugeskr. f. Læger*, Nov. 5, 1925).

ETIOLOGY.—Opium or morphine inebriety has often been the result of careless administration of the opiates to patients for the relief of pain or insomnia, and, in physicians, of their heedless use on themselves. Indeed, the medical profession has often seemed to afford the greatest number of victims. Of 545 morphinomaniacs mentioned by Lacassagne, 289 were doctors.

Whereas in 1916 there were treated at the Philadelphia General Hospital 163 morphine and 313 heroine addicts, in 1921 the corresponding figures were 82 and 526. Heroinists appeared as the plebeian class, morphinists as the aristocrats. The deceit, treachery, and contempt for work of these subjects contrasts with the usual straightforwardness, loyalty, and frequent honest toil of the alcoholic when not in his cups. In any normal man or woman of high ideals and education morphine taken for a week or less, at frequent intervals, will create an autotoxemia, through deficient elimination and consequent toxic absorption, which will produce a subjective need for more of the drug. But a clear distinction is to be made between this type, in which the toxicosis yields easily and lastingly to treatment, and the larger group in which the addiction is but the expression of some underlying abnormal or unmoral trend. This, the correctional case, where drug use is but one of many infractions of the law, should be sent to an **institution**—not a hospital—under commitment, where his stay could be enforced, and where he could be made to support himself by his labors. The other, or **hospital** type, should consist of the more hopeful cases, with education, self-respect, and an honest desire to get well; those whose toxemia has been caused

by illness, chronic pain or other combination of circumstances. J. C. Doane (*Monthly Bull., Dept. of Publ. Health*, Phila., Dec., 1922).

A very short time suffices for the establishment of opium habit. It is readily set up in from four to six weeks. It cannot lay claim to great indebtedness to direct heredity, though its descent through three generations has been observed. In a substantial proportion of opium cases both the inebriate and neurotic inheritance has been traced, in some instances one and in other instances both forms of transmission being present. Under favoring circumstances the progeny of opium drunkards have exhibited a tendency to alcoholic excess, and the children of alcoholists to opiate intemperance.

Few addicts now acquire the habit as the result of a physician's treatment. Association with other addicts is the commonest exciting cause. Of the author's private patients, 75 per cent. were physicians. The majority of addicts come from the quick, nervous, oversensitive, high-strung type of individuals. The nature of the disorder impelling to the use of narcotics is chiefly psychologic. Continued narcosis locks up the secretions and excretions of the body, and katabolic products and intestinal fermentation produce a mixed toxemia. On an attempt to stop the drug, pathognomonic withdrawal symptoms appear. These may last 72 hours, but are not as severe as ordinarily supposed. There is no danger of death when the addict is in fair condition. The drug can be withdrawn abruptly in severe illnesses without the patient's knowledge. In 5000 cases seen in 20 years withdrawal was always sudden, without any deaths resulting. C. E. Scelesh and S. Kuh (*Jour. Amer. Med. Assoc.*, Mar. 1, 1924).

The number of babies forced into the opium habit has been appallingly large, owing to systematic drugging with opium in the form of paregoric or soothing syrup. An infant may become as firmly addicted to opium as an adult, and feels as keenly its withdrawal.

PATHOLOGY.—The pathological changes which have been observed in opiumism are few and limited. The repeated contraction of the vessels impairs the nutritive processes. When the opium habit has become a disease it alters nutrition and perverts vital function.

In general, parasympathetic tonus seems to be increased during addiction and sympathetic tonus during abstinence. There is a symptomatic resemblance between morphinism and hypothyroidia, and also between the abstinence manifestations and hyperthyroidia. Thyroidectomized animals are less sensitive to morphine. The drug seems to depress the thyroid gland and adrenal system. O. Wuth (Munch. med. Woch., Oct. 12, 1923).

PROGNOSIS.—Opium transcends alcohol in the generation of a more irreclaimable and incurable diseased condition. It is much more difficult to abandon the opium than the alcohol habit. It is necessary to continue careful treatment for many months, and no cure can be considered as reasonably permanent until from three to five years have elapsed since discharge without return to the drug.

TREATMENT.—In morphine inebriety, in whatever form the narcotic has been taken, it is desirable to **withdraw the poison** as speedily as may be practicable; but the difficulty lies in the practicability. Among distressing symptoms after sudden withdrawal, the following have been

observed in an aggravated form: Rigors, nausea, vomiting, exhausting diarrhea, convulsions, delirium, prostration, and collapse. Languor and sneezing are minor troubles. The symptoms may be so alarming that the full narcotic dose of the drug has had to be given to avert a fatal issue.

All the suffering may be averted, however, by using **scopolamine (hyoscine) hydrobromide** hypodermically as a temporary substitute. The dose should be small at first— $\frac{1}{200}$ grain (0.0003 Gm.); this is then gradually increased until $\frac{1}{100}$ grain (0.0006 Gm.) or more is administered. Morphine and strychnine being ready antidotes, no fear need be felt of dangerous effects. The painful symptoms attendant upon the abrupt withdrawal of morphine have a natural limit of a few days' duration. By the use of scopolamine these days may be passed in comfort, and the patient enabled to escape the nerve-strain and shock that would necessarily have attended such an ordeal of suffering.

In a series of nearly 400 cases in which Pettey used **hyoscine**, only in 2 or 3 cases were delirium or delusions of any kind present as long as 48 hours after the last dose. In about 1 case out of 10, such symptoms continued 24 hours after the last dose, but in fully 90 per cent. the mind was perfectly clear by the twelfth hour or earlier. In many cases the delirium subsided by the fourth to the sixth hour.

Rapid withdrawal is advocated by F. McK. Bell. Most patients will be found taking from 10 to 15 grains (0.6 to 1 Gm.) a day. One is fairly safe in cutting the maximum in half the first day, then in half again the following day, and so day by day until none is being used.

Barbital is helpful in combating withdrawal symptoms, keeping the patient more cheerful during the treatment. Hornung (Munch. med. Woch., Apr. 23, 1920).

Good results in 93 addicts from **Horovitz's lipoidal substances**, 1 c.c. daily. During opiate addiction the lipid content of the nervous tissues is greatly reduced, and Horovitz ascribes the addiction to the absence of lipoids in the system. The lipoids given gradually reduced the craving and the patients did not suffer torment during withdrawal; the respiration, heart action, and bowel action were rendered normal. F. Burns (N. Y. Med. Jour., Jan. 29, 1921).

Ambulatory treatment is useless. Home treatment should be discouraged, because of the difficulty of absolute isolation. The writer's practice is to **withdraw all of the drug immediately**, unless the patient comes with withdrawal symptoms, when sufficient opiate is given to relieve the vomiting and instill confidence. During the withdrawal period the patient is given **hyoscine hydrobromide**, $\frac{1}{100}$ grain (0.0006 Gm.) every third hour, subcutaneously, until mild delirium is produced. This state is maintained for 3 or 4 days, with generous use of **mercurials** and **salines** meanwhile. A **daily hot bath** is useful as eliminant and relaxant. **Barbital** and **bromides** are given for insomnia after stopping the hyoscine. The **diet** should be **liquid** and **generous**. When dehydration is extreme, and the stomach not retentive, **liquid** by bowel, under the skin, or in the veins is useful. Very occasionally, in the aged or weakened, withdrawal must be gradual. The commonest complications in narcotism are pulmonary tuberculosis, secondary anemia, needle abscesses, and myocardial degeneration. **Change of environment, massage** and **tonics**, the **constant supervision** of a companion or attendant, and avoidance of the word "cure" for at least a year, are indicated in the most difficult part of the treatment, *vis.*, that which comes after acute withdrawal. Doane (Mthly. Bull., Dept. of Publ. Health, Phila., Dec., 1922).

Little good was witnessed from bromides and narcotics, including chloral, in the treatment of morphine

addicts. The **antipyrin** group is more advisable. Injection of **cholin** gave Klee and Grossmann promising results. O. Wuth (Münch. med. Woch., July 4, 1924).

If scopolamine hydrobromide should not be available, **potassium** and **sodium bromides** may be used to subdue the extreme nervous irritability, with **hyoscyamus** and **cannabis**. The quantities given must vary in the individual cases. Von Hösslin has used large doses of **phenobarbital**.

In diacetylmorphine addiction, A. Lambert has found **physostigmine** and **pilocarpine** very useful.

A daily morning **hot pack**, lasting 2 to 3 hours, is continued for 8 to 10 days. The diarrhea which follows the **immediate withdrawal** should not be checked. One ounce (30 c.c.) of **sodium phosphate** is given daily, until the desired depletion has been secured, and then 1 dose of **castor oil** given. A **single dose of morphine** early in the treatment may be required if there are signs of collapse. The treatment never has to be continued longer than 10 days. H. Mason Smith (Jour. Fla. Med. Assoc., Jan., 1916).

Dangerous acid intoxication may arise during morphine withdrawal, and may be an element in sudden collapse. This may be avoided by giving enough **sodium bicarbonate** to keep the urine neutral before beginning the reduction of morphine. J. E. Talley (N. Y. Med. Jour., June 9, 1917).

To brace the heart, **digitalis** and **strophanthus** are invaluable.

There is often severe and prolonged vomiting during the earlier stages of gradual treatment. This is avoided by beginning with a **calomel** purge followed by a **Seidlitz powder**.

While many physicians depend entirely upon saline cathartics to empty the intestine these alone do not give satisfactory results. The following are

given as examples of physiologically balanced purgative combinations:—

℞ *Hydrargyri chloridi mitis*,
Extracti rhamni
purshiana, āā gr. x (0.6 Gm.).
Ipecac. pulv. . gr. j (0.06 Gm.).
Strychninae ni-
tratis gr. $\frac{1}{8}$ – $\frac{1}{16}$ (0.008–0.01
 Gm.).
Atropinae sul-
phatis gr. $\frac{1}{50}$ (0.0012 Gm.).

M. et ft. capsulæ no. iv.

Sig.: One every two hours, preferably at 4, 6, 8, and 10 P.M., fasting.

In all patients addicted to a narcotic drug, the strychnine in each of the foregoing formulæ should be increased to the extent of from 50 to 100 per cent.

The following pill is considered by the author one of the best of its kind.—

℞ *Aloini* gr. ss (0.03 Gm.).
Strychninae ... gr. $\frac{1}{60}$ (0.001 Gm.).
Extracti bella-
donnae foli-
orum gr. $\frac{1}{8}$ (0.008 Gm.).
Ipecacuanhae
pulveris gr. $\frac{1}{16}$ (0.004 Gm.).

M. et ft. pilula no. j.

G. E. Pettey (Narcotic Drug. Dis. and Allied Ailments; N. Y. Med. Jour., Aug. 29, 1914).

As a specific, Lambert recommends the following formula, which has been found effective by a large number of observers:—

℞ *Tinct. of belladonna* .. f̄ij (60 Gm.).
Fl. ext. of xanthoxylon,
Fl. ext. of hyoscyamus,
 of each f̄ij (30 Gm.).

The treatment should be started by giving 4 compound **cathartic pills**, 5 grains (0.3 Gm.), of **blue mass** and a **soapsud enema**. When catharsis begins 6 to 8 minims (0.36 to 0.5 c.c.) of the above mixture are given every hour. The dose is then increased 2 minims (0.12 c.c.) every 6 hours, until 14 to 16 minims (0.84 to 1 c.c.) are taken hourly or the patient begins to show toxic effects, when the mixture is stopped, resuming again in 8-minim (0.5 c.c.) doses

hourly, when the toxic effects subside. **Morphine** is given besides the belladonna mixture, but only $\frac{1}{2}$ or $\frac{3}{4}$ of the dose which the patient has been taking, and in 3 equal doses at half-hour intervals. The bowels must be kept open. After about 30 hours, **strychnine**, **digitalis**, or **strophanthus** should be begun. This treatment removes the desire for morphine (also cocaine and alcohol) in about 5 days. EDITORS.

New method. The patient is put to bed and his morphine stopped entirely. He is put on semisolid or liquid diet and is given **cathartics** as prescribed in the Towns-Lambert treatment. He thus receives 3 or 4 cathartic courses, consisting of 5 grains of blue mass with 5 compound cathartic pills at intervals of 18 hours. Some hours after the last cathartic course he is given **castor oil**. In addition the patient receives from 2 to 4 intravenous infusions a day of 1000 c.c. of 0.9 per cent. **saline solution**. During the first few days the patient is given enough **chloral** at bedtime to ensure a night's sleep, and to blot out large periods of discomfort and fortify him mentally and physically. The liquid diet is continued as long as the patient feels any nausea, and he is kept in bed during the cathartic period and until all acute discomfort from the withdrawal of morphine has disappeared. The patients showed no ill effects. Repeated infusions do not produce anemia. It was not found necessary to give cardiac stimulants to any of the patients. Bluemel (Jour. A. M. A., Feb. 22, 1919).

Ice, milk and lime-water, or milk and soda-water will aid in counteracting the vomiting.

In all cases great attention should be paid to the **diet**, which should be **nourishing**, easy of digestion, and such as will not be rejected by the stomach when the appetite improves.

C. E. DE M. SAJOUS

AND

L. T. DE M. SAJOUS,

Philadelphia.

OPTIC NERVE AND RETINA, DISEASES OF THE.—The optic nerve and the retina, forming, together, an offshoot of the central nervous system, show the closest association in their diseases, which are largely dependent on general disease and disease of other organs. Being open to inspection and minute investigation, they furnish valuable diagnostic and prognostic indications regarding the conditions with which they are associated.

RETINITIS.—Retinitis is an inflammation of low grade and extremely chronic. Heat and pain are absent, redness is often confined to doubtful changes in the retinal vessels, and swelling is evident chiefly through the opacity of the exudate.

SYMPTOMS.—Impairment of vision is the only constant subjective symptom; and it is not characteristic, and tells little of the cause or gravity of the disease. In the early stages it appears as a diffuse clouding of the field of vision or some part of it. Later it may be a distortion of objects (*metamorphopsia*) or an annoying quivering of the thing looked at. In some forms impairment of vision is greatest by a bright light: *day-blindness*. In others it is greater by feeble illumination: *night-blindness*. Flashes of light sometimes occur, but they may not be noticed at all. The important symptoms are wholly ophthalmoscopic. They include opacity of the retina, alteration of the retinal vessels, hemorrhage, and pigment deposits and alterations.

Opacity hides the retinal pigment-layer, and the color or details of the choroid, which are visible through the normal retina. The opacity may appear as a gray veil, blurring or en-

tirely obscuring the deeper structures, or it may have the form of definite dirty-white, or clear, glistening-white masses. Its effect on the retinal vessels varies with their depth in the retina. A vessel running on the surface of the retina is more distinctly seen than normal, because of the contrast furnished by the gray or white opacity of the retina behind it. But a portion of a retinal vessel imbedded in the retina will be partly or entirely hidden by the opacity.

The retinal vessels may be distended uniformly or irregularly. Distention renders the visible vessels larger, and more of the small vessels visible; and it also makes the vessels more tortuous. The tortuosity is shown both by the wavy outline in the plane of the retina and by more decided differences of level in different parts of the vessels; so that some parts stand out with greater distinctness, while others are comparatively buried in the depths of the retina. Irregular distention of the retinal veins occurs in retinitis, indicating disease of the vessel walls.

Retinal hemorrhage is liable to occur in violent retinitis of any kind, causing dark-red spots in the fundus. When it takes place into the nerve-fiber layer, the blood becomes diffused in the direction of the bundles of fibers, forming what are known as "flame-shaped" patches, narrower toward the optic nerve, wider and having a "feather-edge" in the opposite direction. In time the dark-red spot of hemorrhage disappears. It may be followed by a patch of white or a marked disturbance of pigmentation.

Subhyaloid hemorrhages are large, rounded areas of hemorrhage, located near the posterior pole of the eye,

and often shifting their positions from day to day, situated between the retina and vitreous. They undergo absorption with, sometimes, full restoration of vision.

Pigmentation.—Patches of retinal inflammation are often followed by atrophy of the retinal pigment-layer or the formation of black pigment-blotches. These develop slowly and may become visible when the inflammatory opacity and swelling have so far subsided as to permit a view of deeper structures; or, in the more chronic forms, there is a slow migration of pigment-cells which may accumulate around the retinal vessels.

VARIETIES.—**Simple or serous retinitis** may be caused by eye-strain, choroidal inflammation, or obscure constitutional conditions. It may be limited to small, isolated areas. The affected parts of the retina appear gray or bluish, with indefinite edges. It affects one or both eyes.

Purulent retinitis results from injury, as a penetrating wound or the lodgment of a foreign body in the vitreous; or, it may be a *septic, metastatic*, or *embolic* retinitis, arising in connection with pyemia, puerperal fever, etc. It may present only small, white spots, and hemorrhages scattered throughout the retina; or it may be indistinguishable from purulent choroiditis, ending in panophthalmitis or in chronic purulent accumulation in the vitreous: *pseudoglioma*.

Renal retinitis commonly attends chronic, non-exudative, or interstitial nephritis. (See BRIGHT'S DISEASE, volume ii.) It arises in connection with severe toxemia, or with advanced disease of the retinal vessels. It is not an early symptom, but it is often the first symptom that leads to a cor-

rect diagnosis. It often presents a characteristic appearance, consisting of white dots, arranged somewhat in lines that radiate from the fovea. There are retinal hemorrhages, usually "flame-shaped," and irregular dilatation of retinal veins. The optic nerve may be involved in the inflammation. There may also be extensive masses of retinal exudate. Both eyes are commonly affected. The appearance of this form of retinitis in chronic Bright's disease commonly indicates a fatal termination of the case within a year or two. To this rule there are many exceptions among patients who are well-to-do and can control the conditions under which they live, avoiding strain, exposure, and unsuitable diet.

Vision is not usually lost completely as a result of albuminuric retinitis. If, as often happens, the macula is implicated, the patient is unable to read or recognize a friend on the street, but the peripheral field may be intact. A. M. Ramsey (Pract., May, 1925).

The retinitis of pregnancy closely resembles renal retinitis; but if the pregnancy is promptly terminated, partial or complete recovery usually ensues.

Leukemic retinitis occurs in leukemia and pernicious anemia. (See ANEMIA, volume i.) The whole fundus may be obscured by the retinal swelling, and often has a markedly yellowish color. Retinal hemorrhages are numerous and the retinal veins may be enormously dilated, while both arteries and veins are comparatively pale. Both eyes are affected.

Hemorrhagic retinitis, or **retinal apoplexy**, is marked by hemorrhages in all parts of the retina, which recur again and again. It depends on

thrombosis of the retinal veins. Vision is greatly impaired, and hemorrhagic glaucoma is likely to ensue. One eye is likely to be affected earlier or to a much greater extent than the other.

Gouty retinitis occurs in elderly gouty persons. There are yellowish-white patches of exudation. The vessels are irregularly narrowed, with thickening of their walls. In the early stages there are hemorrhages. Impairment of vision is progressive, but rarely goes on to complete blindness. No sharp line can be drawn between the conditions of renal or gouty retinitis and the retinal changes of arteriosclerosis.

In 45 per cent. of the writer's cases 1 eye was involved, while both were involved, one soon after the other, in nephritis. It is also far more chronic than nephritic retinitis. The retinal changes throw light upon the state of the cerebral vessels. Moore (*Quar. Jour. of Med.*, Jan., 1917).

Diabetic retinitis is characterized by ivory-white dots of exudation—most numerous near the posterior pole of the eye, but not grouped in any special figure—and points or larger spots of hemorrhage.

Case of Hirschberg's central punctate retinitis connected with diabetes. Immediate improvement followed **insulin** treatment—a result ascribed to the influence of insulin on fat metabolism, the white spots on the fundus diminishing. Chauffard, Grigaut and Nida (*C. r. Soc. de biol.*, May 22, 1925).

Syphilitic retinitis is one of the late secondary lesions. It is commonly attended by choroidal disease and dust-like opacity of the vitreous. The retinal exudate may be localized, especially at the macula or in a zone around the optic disk. Vision is al-

ways permanently impaired. The optic disk may be at first red and swelled, and later undergo atrophy, becoming yellowish in color, with narrowed retinal vessels.

Punctate retinitis shows numerous white or yellowish-white points scattered throughout the fundus, with some impairment of vision. It is probably the permanent condition following some active disease, or any early change that later passes over into retinitis pigmentosa.

Circinate retinitis is characterized by a wreath of brilliant white spots near the macula or the optic disk, or including both these regions. This appearance is preceded by retinal hemorrhages. Vision is permanently impaired through changes that always involve the macula. These are permanent, although the brilliant white spots may entirely disappear.

Striate Retinitis.—In this form of retinitis yellow or gray lines or streaks appear in the retina. Sometimes they are straight, as if drawn upon; in other cases curved, but not conforming to any normal structure. They may follow detachment of the retina, if the detached portion resumes its normal position.

Proliferating retinitis includes cases in which masses of opacity, probably following large hemorrhages, extend from the retina into the vitreous.

Retinitis from excessive light occurs after looking at the sun without sufficient protection, as after watching an eclipse. A small central scotoma occurs, attended and followed by persistent dazzling and metamorphopsia.

After the eclipse of April, 1912, fully 3500 such cases occurred in Germany. Of 188 cases, 55 showed

slight changes in the macula, and in 49 there were marked pathological alterations. There was a scotoma, central in 128 cases, paracentral in 6, oval in 4, crescentic in 4, ring scotoma in 2 and star-shaped in 1, but in the mass of cases round. It varied in size from less than one-half degree to one degree. Werdenberg (*Zeit. für Augenheilkunde*, vol. xxx, p. 273).

After exposure to the arc electric light at a short distance the same trouble may develop; but it is at first attended with smarting, burning, and swelling of the conjunctiva, probably dependent on the short wave radiations that reach the conjunctiva, but not the deeper structures of the eye, from the arc light.

Retinitis pigmentosa is a condition of retinal degeneration, usually congenital. It is characterized by night-blindness, great narrowing of the visual field, the deposit of pigment-masses in the retina, narrowing of the retinal vessels, and atrophy of the optic nerve. The pigment-spots are branching, often the shape of bone-corpuscles. They appear first and are most numerous in the periphery of the fundus. The night-blindness is commonly noticed in early childhood, and the disease is slowly progressive until at the age of 60 most cases end in complete blindness. Sometimes a very similar condition, but running a more rapid course, occurs in tertiary syphilis. In a few cases, otherwise similar, no pigment-deposits occur. The degeneration of the retina depends on a sclerosis of the smaller or superficial vessels of the choroid causing atrophy of the layer of rods and cones. The pigment spots are due to the migration of pigment-cells, which often come to form a wrapping around the shrunken retinal vessels.

Amaurotic family idiocy is attended with a white opacity of the retina about the macula, with a red spot in its center, and blindness soon becoming complete from degeneration of the nerve-cells of the retina. It comes on during infancy or early childhood, with general asthenia due to similar changes in the cerebral cortex.

Angioid streaks in the retina, brownish streaks of pigment-deposit which have the shape of a vascular network, but which do not conform to the visible retinal or choroidal vessels, mark a special form of a retinal degeneration. Vision is impaired, and the streaks are preceded by retinal hemorrhages.

DIAGNOSIS.—Retinitis must not be confused with blurring of the retinal vessels and other details of the fundus due to errors of refraction, especially regular astigmatism. Blurring from an error of refraction affects all parts of the fundus, or all parts of the retinal vessels running in a certain direction. Retinitis affects only certain portions of the fundus, or some parts more than others, and veils the vessels running in one direction no more than those running in another. The haziness caused by dust-like, localized opacities of the vitreous simulates that of retinitis. Patches of serous retinitis may closely resemble detachment of the retina. The appearance of the retinal vessels upon the surface, with prominence of the swelling and the involvement of a large area, indicates detachment.

Retinitis is generally followed by degenerative changes, and many of the symptoms characterizing its various forms are really degenerative. The diagnosis between the different varieties is indicated in their de-

scription. In determining the form of the retinitis other symptoms of the underlying general condition should also be sought for and carefully considered. Thus renal retinitis may be exactly simulated by the retinal symptoms of organic disease of the brain; and only the renal or the cerebral symptoms can establish the diagnosis.

PROGNOSIS.—This depends on the cause of the retinitis. Simple inflammation from eye-strain may end in complete recovery. Purulent retinitis commonly destroys the eyeball, but the form characterized by small, white spots may go on to incomplete recovery. Albuminuric and leukemic retinitis may improve under treatment, but they partake of the grave prognosis of the underlying diseases. Toxemic retinitis arising during pregnancy may undergo very marked improvement. Retinitis pigmentosa goes slowly on to hopeless blindness. Other forms of retinitis rarely cause complete blindness; but vision once lost through them is not regained, or is only partly recovered.

TREATMENT.—**Rest for the eyes and avoidance of bright light and sudden changes of illumination** are important, in the active stages of retinal inflammation. Rest must include the use of **lenses correcting any ametropia**, and may require the use of **colored glasses** or a **cycloplegic**. **Removal of the cause** or appropriate treatment of the underlying dyscrasia comes next in importance. After the acute stage has passed, the retinal degeneration succeeding it is best met by **tonics**, and especially **strychnine**, in doses ascending to near the limit of physiological tolerance. Retinitis pigmentosa requires a very **moderate use of the eyes** and the **tonic treatment**

throughout. Instillations of a weak solution of **physostigmine** may be employed; and the application of a weak **galvanic current**, $\frac{1}{4}$ to 1 milliampère, has been credited with benefit.

RETINAL VASCULITIS AND PERIVASCULITIS.—Great impairment of vision, often arising from hemorrhage into the retina or vitreous, calls attention to disease of the retinal vessels. Often the hemorrhage and opacity caused by it hide the changes going on in the vessel walls. When these are seen they are blurred or covered by the exudate; parts of the veins may be greatly dilated or tortuous; parts of the arteries entirely hidden by gray masses in which new-formed vessels arise. Sometimes the retina is greatly thickened. These cases have been known as cases of massive exudation into the retina. Others are marked by repeated hemorrhages, the recurring hemorrhages of early life. Some cases are due to *tuberculosis* of the retinal vessels, although evidences of the disease in other organs may be slight or entirely wanting. These cases are shown by a positive general or local reaction to **tuberculin** injections, and may be cured by therapeutic doses continued once a week for several months.

RETINAL ANGIOMATOSIS (von Hippel's disease) is characterized by rounded red bodies in the retina into each of which enter one or more dilated arteries and dilated veins. One part of the retina after another is affected, and the case ends in blindness, retinal detachment, and glaucoma.

RETINAL ANGIOSCLEROSIS.—The changes in the retinal vessels revealed by the ophthalmoscope are

often the earliest evidence of arteriosclerosis. The arteries become narrowed or irregular in caliber, and the blood-stream may be hidden by opaque-white patches in the vessel wall. The veins become irregularly dilated and tortuous; but where they are crossed by the arteries are hidden on each side of the artery, narrowed, and abruptly bent or "kinked." White lines may run parallel on either side of the vein, or parts may be hidden by patches of opacity in the walls.

EMBOLISM AND THROMBOSIS OF THE CENTRAL RETINAL ARTERY.—These cause sudden blindness of one eye, usually permanent.

Symptoms and Diagnosis.—There is general haziness of the retina, most intense near the posterior pole of the eye, with a dark-red spot at the macula. When one or more branches of the central artery escape obstruction, a corresponding portion of the field of vision is retained. When the macula is supplied by a cilioretinal artery, full central vision may be preserved. At first the retinal arteries retain their normal appearance, while the veins are usually narrowed or partially collapsed. Later both arteries and veins become greatly shrunken, and the optic disk white and atrophic. The two conditions are to be distinguished from each other chiefly by the presence of some probable source for the embolus in embolism; or preceding symptoms of vascular disease, as brief obscurations of vision, for thrombosis.

Prognosis and Treatment.—In thrombosis the recovery of vision is very improbable. In a few cases of embolism some vision is recovered. Either spontaneously or under treat-

ment the embolus may be broken up and pass onward into some branch of the artery, and even into such peripheral branches that its effects are no longer noticed. To favor such a termination the **inhalation of amyl nitrite** may be pushed to a decided physiological action, and active **massage of the eyeball** employed. These should be repeated daily for several days before abandoning hope of improvement. If the embolus is dislodged, **strychnine** may be indicated to promote restoration of the retinal function.

THROMBOSIS OF THE CENTRAL RETINAL VEIN causes blindness, less sudden and complete than that due to the obstruction of the artery. It is attended by dilatation of the retinal veins and hemorrhages throughout the retina, and may be followed by hemorrhagic glaucoma. The treatment is that of the general condition accompanied by the retinal disease.

DETACHMENT OF THE RETINA is a displacement of the retina from its normal position. This may be caused by a tumor or by a displacement of the choroid. But the term is commonly understood to mean a separation of the retina from the choroid by serous fluid.

Symptoms.—There is impairment of vision often sudden, and affecting but a portion of the visual field. Commonly a subretinal effusion settles to the lower part of the eye, so that the upper part of the field of vision is lost. The detached portion of the retina may float in front of some part still normal, causing sudden temporary loss of vision. With the ophthalmoscope a gray veil is detected, hiding more or less completely

the normal red of the eyeground. It presents rounded folds, which float, as the movements of the eye disturb the fluid beneath. These folds are more hyperopic or less myopic than the undetached parts of the retina that may be seen above them. On the folds may be traced the retinal vessels, appearing very small and dark in color.

Diagnosis.—The rounded gray folds with the retinal vessels on them are unmistakable. It is sometimes more difficult to decide if the case is one of simple detachment or one of detachment due to new growth. Movement of the folds of retina, after moving the eye, indicates that it is floating freely on serous fluid. When attached to a choroidal growth no such movement occurs; and the vessels of the growth, resembling choroidal vessels, may be seen through the retina. When a new growth exists, but the retina is separated from it by serous fluid, the growth may be perceived through the retina by making the ophthalmoscopic examination with direct sunlight; or transillumination of the eyeball may give evidence of a subretinal tumor, usually a sarcoma of the choroid or ciliary body. The tension of the eyeball may throw some light on the case, being normal or below in simple detachment and sometimes elevated in cases of tumor. The recognition of detached retina accompanying cataract is important as influencing the prognosis regarding the results of operation. It must depend chiefly upon the careful testing of the field of vision.

Etiology.—Blows on the eye or head may cause detachment of the retina, either primarily or as the re-

sult of other changes in the eye. Very myopic eyes are especially liable to it, and the liability increases with age. Extensive changes in the vitreous, especially cicatricial contraction, may pull the retina away from the choroid. Sometimes a tear may be recognized in the detached retina, apparently due to such traction. Through it the choroid may be clearly seen with the ophthalmoscope.

Prognosis.—A small proportion of patients recover spontaneously. This most frequently occurs in traumatic cases. In a large proportion of cases no treatment will effect the permanent replacement of the retina and restore sight. There is no hope of cure for eyes having excessive myopia or great alterations of the vitreous.

Treatment.—An opening through the sclera permitting the subretinal fluid to escape externally, **with or without an opening through the detached portion of the retina** to allow it to pass freely into the vitreous, has usually caused a temporary improvement, and rarely, permanent relief. The burning with the **galvanocautery** of 1 or 2 holes in the sclera that will close only after several days or weeks is claimed to be more efficient.

By causing adhesion of retina to choroid by small knife **punctures** and injection of 1:1000 **mercury cyanide** solution into the resulting subconjunctival vitreous effusions, or by making fine **galvanocautery** punctures, 9 of 18 long-standing detachments were cured and 5 improved. Sourdille (Bull. Acad. de méd., June 5, 1923).

The greatest chance of permanent restoration is given by **prolonged rest in bed**, with the eyes covered most of the time with a **pressure bandage**, and the use of **pilocarpine sweats** and **potassium iodide** or **salicylic acid**.

Sometimes a **part of the distended sclera** has been **excised**, reducing the enlarged eyeball so that the retina will be pressed against the choroid by the vitreous, the force which normally keeps it in proper position.

GLIOMA OF THE RETINA—or, more strictly, **gliosarcoma of the retina**—is a malignant new growth occurring in early childhood.

Symptoms.—Attention is usually first attracted by the appearance of a yellowish reflex in the somewhat dilated pupil, and the eye is found to be blind. On examination the reflex is found to be due to a growth situated back of the lens. It has a silvery or yellow, shining appearance, and small blood-vessels may be seen on it. As it increases the lens and iris are pushed forward, the tension of the eyeball becomes elevated (second, or glaucomatous, stage), and symptoms of irritation and inflammation appear. When the growth perforates the sclera (third stage) the tension falls, and for a few days the symptoms may seem to abate. Soon, however, the growth causes a noticeable tumor in the orbit, which increases more and more rapidly. Involvement of the brain through the optic nerve or of other organs (fourth stage) quickly occurs, and causes death. Sometimes the growth sets up an iridocyclitis that leads to diminished tension and shrinking of the eyeball (*cryptoglioma*), which, however, ends in the further extension of the tumor. In a large proportion of cases both eyes are affected.

Diagnosis.—The only affection liable to be confused with typical glioma of the retina is chronic purulent accumulation in the vitreous, or *pseudoglioma*. This gives rise to a

yellow reflex back of the lens, commonly exhibiting no vessels. Such an accumulation follows purulent retinitis or choroiditis, generally as a sequel to some acute febrile disease, as scarlet fever or cerebrospinal meningitis. Glioma gives no history of antecedent disease. In pseudoglioma the tension of the eyeball is almost always diminished. In glioma it is normal or elevated. Pseudoglioma remains stationary; glioma is progressive. In cryptoglioma diagnosis may, for a time, be impossible. But the eye, being blind, to treat it as the seat of glioma is proper in any doubtful case.

Treatment and Prognosis.—The treatment for glioma of the retina is **removal of the eyeball** at the earliest moment, with so much of the optic nerve as can be readily taken with it. If the growth has reached the third stage the removal of the whole contents of the orbit is necessary. Without complete extirpation of the tumor it always causes death. After early removal of the eye about one-third of the cases remain permanently free from the disease. But only the lapse of a sufficient period of time, at least three years, can give positive assurance that there will be no recurrence.

OPTIC NEURITIS, PAPILLITIS, PAPILLEDEMA, OR CHOKED DISK is a swelling or inflammation of the ocular end of the optic nerve. It is important as a symptom of the diseases which cause it, and on account of the atrophy and impairment of vision which are liable to follow it.

Symptoms.—The essential symptoms, hyperemia and swelling, are only discoverable by the ophthalmoscope. Hyperemia at first causes the optic disk to appear redder, and more

uniform in color than normal. At the same time exudation causes blurring or complete obscuration of its outlines; so that the location of the disk may only be recognized by the convergence to it of the larger retinal vessels. As the inflammation advances, the swelling becomes greater; and measurement of their refraction with the ophthalmoscope shows that the vessels at the center of the disk are pushed forward into the vitreous. With the increased swelling the small vessels become separated by exudate, and the general color of the disk becomes more gray. The individual vessels, greatly enlarged and tortuous, appear and disappear in the swelling. The principal branches of the retinal arteries are small from compression at the point of entrance to the eye; and from compression at the point of exit the veins are swelled, dark, and tortuous. Hemorrhages occur mostly on or near the disk. Vision may not be noticeably impaired. It may remain practically normal, even with great swelling. When impairment of vision does occur, it is rather a sign of optic atrophy secondary to the neuritis, or of involvement of the visual centers or optic tract within the cranium. The course of the disease is essentially chronic, sometimes lasting for many months, or even several years, when caused by a slowly growing tumor. Ultimately, if the patient lives long enough, the swelling becomes paler and diminishes, and the process passes over into one of optic atrophy. Commonly both eyes are affected, although often one earlier or more severely than the other.

Monocular neuritis may occur from sinus disease or other local cause.

Diagnosis.—This rests on the ophthalmoscopic appearances above described. In a severe case these cannot be mistaken. But a commencing neuritis may easily be confused with hyperemia and slight haziness of the disk, often seen with eye-strain, and in rare cases protrusion and haziness exist as a congenital anomaly. In these doubtful cases repeated observations must be made. At this stage neuritis is progressive, the swelling and the alterations of the vessels increasing, while conditions with which it might be confused remain unchanged for a long period. *Subsiding neuritis*, which might also be overlooked, is likely to be attended by impairment of vision, especially by irregular contraction of the field of vision; and by opacity of the nerve-head hiding its deeper details, pigment-disturbances about the disk, and opacity of the walls of the retinal vessels or irregularities in the caliber of the same vessels.

Etiology and Pathology.—A mild form of optic neuritis may arise from eye-strain. Syphilis, influenza, lead poisoning, Bright's disease, and extension of inflammation from adjoining structures may cause it. But the larger number of cases are due to organic disease of the brain and its membranes, especially tumor, meningitis, and abscess.

[In a large series of cases Uthoff found 71 per cent. caused by brain tumor, 12 per cent. by cerebral syphilis, and 3.6 per cent. by tuberculosis. He found that some involvement of the optic nerve was present in 79 per cent. of cases of tumor of the cerebrum; 88 per cent. of tumor of the cerebellum; 95 per cent. of tumors of the pons; 38 per cent. of tumors of the hypophysis, and 49 per cent. of tumors of the corpora quadrigemina. JACKSON].

The principal theories to account for papilledema are: 1. That the inflammation reaches the nerve-head by direct extension from within the cranium, either through the nerve-trunk or along its sheath. 2. That the inflammation is due to "choking of the disk" by intracranial pressure, transmitted by the veins or the lymph-spaces around the nerve to its point of entrance into the eyeball, where the sheath of the nerve is usually found dilated. 3. That the inflammation of the nerve-head arises through a nerve influence controlling its nutrition, and originating in afferent nerves distributed to the cerebral meninges. 4. That toxic substances make their way along the lymph-spaces surrounding the optic nerve from the cranial cavity to the nerve-head, where they excite inflammation. None of these theories seems consistent with all the facts, and it is probable that various influences contribute to the result. Relief of intracranial pressure is often followed by improvement in the neuritis, and Deyl suggests that the pressure may act by "choking" the central retinal artery and vein where they enter the optic nerve back of the eye.

Prognosis.—If the cause of the optic neuritis is one that can be removed, or the intracranial pressure can be permanently reduced, partial or complete recovery is likely to follow. Otherwise the neuritis passes into an optic atrophy, and blindness results. On this account, trephining to prevent blindness is justified. In a few cases the cerebral disease passes on to spontaneous recovery; but it may not do so until it has caused blindness, and the blindness may be permanent.

Treatment.—Besides the efficient treatment of its cause and especially the treatment for syphilis in all doubtful cases, the standard treatment for optic neuritis of intracranial origin is by **potassium iodide** in doses rapidly increased up to the limit of tolerance. Tapping the sheath of the optic nerve has been tried with the idea of relieving pressure, but it is of doubtful benefit. In these cases vision may be preserved by a timely operation for relief of intracranial pressure. Even if the cerebral disease be incurable and progressive, the preservation of vision to the end of life is a result that justifies operation.

RETROBULBAR OPTIC NEURITIS is marked by pain in the orbit and soreness or tenderness on moving the eye or pressing it backward. Vision is impaired in some part of the field of the affected eye, and it may be entirely lost or reduced to mere light perception in a few days or hours. Commonly the impairment is greatest at the center of the field. At first the disk may appear normal, or slightly swelled and hazy. Later it may show signs of atrophy. Recovery usually occurs, and vision may be completely restored. The causes are disease of the accessory sinuses of the nose, syphilis, acute fevers, and alcoholic or other poisoning. (See TOXIC AMBLYOPIA.) It may attend degenerative disease of the brain and spinal cord. It is to be treated through its cause, and by **local blood-letting, potassium iodide, and, later, strychnine.**

OPTIC ATROPHY.—Atrophy of the optic nerve consists essentially in atrophy of some or all of its nerve-fibers. It is always attended by impairment of vision, and is a common

cause of permanent blindness. It is also important as a sign of disease in the central nervous system.

Symptoms.—The impairment of vision generally affects central vision, and always includes some limitation of the visual field. It is at first progressive. The fields for colors are usually contracted earlier and to a greater extent than the field for form; and they may be obliterated, producing acquired color-blindness. When the blindness is complete, especially if it has come on rapidly, the pupils may be widely dilated. More commonly the pupils are not greatly enlarged. With the ophthalmoscope the optic disk is found less vascular than normal. It may be a dead white, or gray, bluish, or greenish hue. It presents few small vessels. The large branches of the retinal vessels may be of normal size, or they may be greatly contracted.

Etiology and Varieties.—Atrophy, not due to preceding disease of the optic nerve or retina, or to injury, or to pressure on the nerve or chiasm, is called *primary atrophy*. It may be congenital or hereditary or may follow acute disease or syphilis. It sometimes accompanies or precedes spinal sclerosis, or is caused by poisoning by lead, alcohol, etc. Atrophy following injury to, or pressure upon, the optic nerve is called *secondary*. *Consecutive atrophy* is atrophy following disease of the retina or choroid, as embolism of the central retinal artery or syphilitic chorioretinitis. Its causes are those of the conditions it follows. *Postneuritic atrophy* follows optic neuritis.

Diagnosis.—The ophthalmoscopic picture of advanced atrophy is usually quite striking. But commencing atro-

phy cannot be certainly recognized with the ophthalmoscope; and even the appearance of pronounced atrophy may be simulated in disease, like quinine blindness, or ischemia of the retina from severe hemorrhage, which admits of partial or complete recovery. The diagnosis is most safely based on narrowing of the field of vision, particularly for colors, with ophthalmoscopic appearances that point toward atrophy.

In primary atrophy the disk is usually gray and its details, with the lamina cribrosa, very distinct. The retinal vessels are not greatly narrowed. The field of vision is contracted regularly. In secondary atrophy the disk is more likely to be white. The retinal vessels may or may not be contracted. In consecutive atrophy the nerve-head is usually opaque, the neighboring choroid disturbed, and the retinal vessels somewhat contracted and often irregular in caliber. The visual field is irregularly contracted. After chorioretinal disease the disk shows dirty-yellowish color, and the lamina is hidden.

Prognosis.—Primary atrophy generally goes on to blindness. The prognosis for secondary and consecutive atrophies depends on early treatment and the possibility of controlling the cause.

Treatment and Prognosis.—The most effective measures are those directed to the causes of the atrophy, and they must be as varied as those causes. In addition, **mercury** and **potassium iodide** may be tried in the early stages, even in cases not of syphilitic origin. Later, **strychnine** should be tried in doses rising gradually to the physiological limit. This is sometimes as high as $\frac{1}{8}$ grain

(0.013 Gm.) three times daily by the mouth, or once daily hypodermically. General measures, including **change of occupation** and **climate**, may be beneficial. **Inhalations of amyl nitrite** and applications of **galvanic electricity** have been tried with reported benefit in some cases.

TUMORS OF THE OPTIC NERVE cause protrusion of the eye and loss of sight. They begin in childhood and develop slowly, without pain or much interference with the movements of the eyeball. They are usually myxomas or fibromas, which do not recur after **removal**.

EDWARD JACKSON,
Denver.

ORBIT, DISEASES OF.—CONGENITAL MALFORMATIONS.—Meningocele—a protrusion of the brain-meninges into the orbit through a lack of development of the wall of the latter—is distinguished from other tumors of the part by presenting an elastic rounded swelling, which pulsates with the heart, and can be reduced by steady pressure until the defect in the orbital walls is revealed.

Anophthalmos, or congenital absence of the eyeball, is a rare condition; and in most cases there is found on dissection a small button of tissue representing the globe, which is often attached to a thin-walled cyst that distends the lower lid. The lids and orbits are commonly smaller than normal.

Microphthalmos, or congenital smallness of the eye, varies from cases that present only high hyperopia to those approaching anophthalmos. In the higher degrees the eyes are always quite defective. Both eyes are commonly affected.

Cryptophthalmos is the condition in which the eyeball, usually small and undeveloped, is buried in the tissues of the orbit, and can only be exposed by operation. There may be defective development or absence of the conjunctival sac and palpebral fissure.

Report of a case where both mother and daughter were thus affected bilaterally. The upper and lower lids were quite continuous. A few cilia were present, but no conjunctival sac. Operation revealed an undeveloped eyeball. Coover (*Ophthalmoscope*, vol. viii, p. 259).

DISPLACEMENTS OF THE EYEBALL.—**Enophthalmos**, or sinking of the eyeball within the orbit, is noticed after exhausting disease, in paralysis of the sympathetic nerve; neurotic facial atrophy, occurring periodically with neuralgia of the fifth nerve; and after traumatism. In the latter case it may be due to fracture of the walls of the orbit or to the influence of cicatricial bands, or absorption of orbital fat.

Exophthalmos, or undue protrusion of the eyeball, may arise from many conditions. It is the most striking symptom of exophthalmic goiter (see GRAVES'S DISEASE, volume v), and may be produced by emphysema of the orbit after fracture of the bones, including the air-passages. It is also caused by hemorrhage into the orbit or inflammation, disease of the orbital walls, new growths, or by paralysis of the ocular muscles, especially those supplied by the oculomotor nerve. Temporary exophthalmos may be produced in some persons by stooping and holding the head low.

PULSATING EXOPHTHALMOS.

This condition is attended with a distinct bruit heard over the

temple and neighboring parts and audible to the patient, is most frequently caused by a rupture of the carotid artery into the cavernous sinus. This may occur spontaneously; or from crushing injuries to the head. Pulsating exophthalmos has sometimes ended in spontaneous recovery. In other cases no lesion was revealed by post-mortem dissection. In a few cases it has been due to aneurism of the ophthalmic artery.

TREATMENT.—Pressure on the carotids, either intermittent, which may be made by the patient himself, or continuous, should be tried. When pressure fails, ligation of the orbital veins should be resorted to. These are usually distended, and may be reached through an incision or incisions near the margin of the orbit. Ligation of one or both carotids has been resorted to for this condition. But de Schweinitz and Holloway found that among reported cases there had been improvement in 65 per cent., failure in 25 per cent., and death in 10 per cent. The results of ligation of the veins have almost always been good.

A boy of 11 struck on the head noticed a buzzing sound followed in a few days by protrusion of the eyeball. After the condition had lasted three months an incision two inches long was made in the eyebrow. Superficial and angular veins were tied, and the superior ophthalmic as far back in the orbit as possible. The bruit and pulsation stopped instantly, and the eye gradually returned to normal position. F. C. Buchtel (*Ophthal. Record*, v. xxii, p. 75).

ORBITAL CELLULITIS.

General inflammation of the extra-ocular contents of the orbit arises

from traumatism, cold, erysipelas, other specific fevers, metastasis in septicemia, thrombosis of the cavernous sinus, or extension of inflammation from the eyeball, or from the walls of the orbit, or the neighboring cavities.

SYMPTOMS.—There is pain in the orbit, and often severe general headache, lessened mobility of the eyeball, protrusion of the eye, and swelling of the orbital tissues and lids. The vision is impaired and diplopia may be noticed. The invasion may be marked by a severe chill, and considerable fever may attend the disease. The eyeball is liable to become involved in the inflammation; and, even if this does not occur, optic neuritis and atrophy are apt to result. There is serious danger of extension to the meninges of the brain, causing death. In a few cases the symptoms are mild and spontaneous recovery occurs in a few days.

TREATMENT.—On the appearance of the earliest symptoms free local bleeding by leeching, or the artificial leech, should be resorted to, and calomel given and followed by a saline purgative. Hot fomentations should be applied, and frequently renewed to keep them as hot as can be borne. Any localized accumulation of pus should be promptly and freely evacuated. Even when no pus has accumulated, it is well to make incisions with a straight bistoury, from the retrotarsal folds of the conjunctiva, parallel with the orbital walls and as near them as possible, to the depth of an inch or more. When swelling of the lids interferes with the making of such incisions from the conjunctival sac, they may be made through the lids, near the orbital



Pulsating Exophthalmos and Glaucoma of the Left Eye.

margin. In any case they should be so placed as to avoid injury to the ocular muscles if possible. If the eyeball has been the starting point of the orbital inflammation, and is so damaged as to preclude vision, it should be promptly enucleated. The general treatment should often include tincture of **iron, quinine, and good feeding.**

Tenonitis, or inflammation of the oculo-orbital fascia, presents many of the symptoms of orbital cellulitis, but in less severe form. The immobility of the eye and pain on movement are relatively great, but the swelling is less general and severe. It arises from traumatism, as from a squint operation, or is of a rheumatic or gouty character.

TREATMENT includes **hot applications**, and **free exit for any pus** that may be formed. Sometimes **local bleeding** is important. The rheumatic and gouty cases yield to **salicylates** or **iodides**; pain may require the use of **anodynes**.

ORBITAL TUMORS.

These cause displacement of the eyeball, dependent on the location and the size of the tumor. Sometimes there is limitation of the movements of the eyeball or double vision. But with slowly growing tumors there may be great displacement of the eyeball, without diplopia or destruction of vision. Pain usually appears late in the progress of the growth.

VARIETIES.—**Tumors of the optic nerve** cause early blindness and optic atrophy; the displacement is usually directly forward or a little outward, and ocular movements remain good. Tumor of the optic nerve is usually fibroma or myxoma, showing little or no tendency to recur after

removal. Removal may require **enucleation of the eye**, or it may sometimes be accomplished without enucleation of the eyeball, by **osteoplastic resection of the outer wall of the orbit** (Krönlein's operation).

Dermoid Cyst.—This variety of growth appears as a rounded, slowly growing tumor, which is seen most frequently at the upper inner angle



Tumor of the orbit. (Vance.)

of the orbit; but it may be situated at the outer angle or the upper or lower margin. It sometimes extends very deeply, to the apex of the orbit or even into the cranial cavity.

Cysticercus and **echinococcic cysts** also occur in the orbit, but are extremely rare in this country.

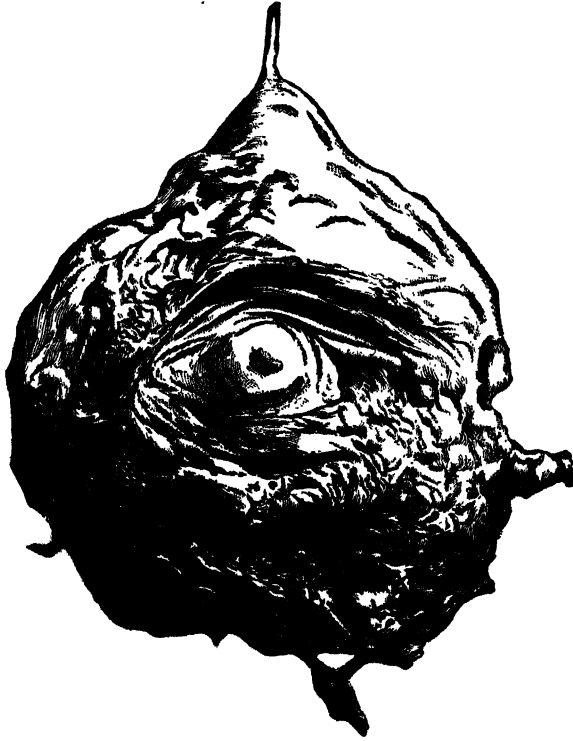
Angiomata, both simple and cavernous, occur in the orbit. They are compressible and commonly involve the lids. They increase in size with crying, or on holding the head down. They rarely exhibit pulsation; and the pulsation is never so marked

as in meningocele or pulsating exophthalmos.

Sarcomata.—These are the important malignant tumors of the orbit. They may be so vascular as to pulsate and be compressible; or they may be hard and fibrous, growing very slowly, and causing great dis-

part of the sac left behind should be cleansed, and tincture of iodine or crystals of silver nitrate placed in it to secure its obliteration. Where possible, benign tumors, even those of the optic nerve, should be removed without sacrificing the eyeball.

For malignant tumors the only



Tumor of the orbit. (Vance.)

placement of the eyeball, without entire destruction of vision.

Carcinoma of the orbit is always secondary to similar disease of the lachrymal gland, lids, conjunctiva, eyeball, or adjoining cavities, or more distant organs.

TREATMENT.—Non-malignant tumors should be **excised**. If a dermoid cyst be so deep that its complete removal by dissection would be extremely difficult or impossible, the

hope for cure is by **complete removal**.

In rare cases, where the eye retains useful sight, removal of the evident new growth must be depended on. But the prospect of future immunity is decidedly improved by the removal of the whole contents of the orbit. Sarcomas of the spindle-cell variety may not return. Other varieties are more likely to recur, and it is doubtful if removal often prolongs life. It is, however, fully justified for the



Tumor of the Orbit.

purpose of relieving pain and affording temporary alleviation.

X-ray treatment favored in primary sarcomas of the orbit. Of 14 cases of primary retrobulbar sarcoma, 9 were free of symptoms after 1 to 9 years; 3 were improving, and 2, failures. In recurrent sarcoma it usually fails, though 8 of 9 cases showed improvement for 2 to 15 months. Pfahler (Jour. Amer. Med. Assoc. Jan. 10, 1925).

MISCELLANEOUS ORBITAL DISEASES.—**Mucocele** or **empyema of the frontal, ethmoidal or maxillary sinus** reaches the orbit sometimes by bone absorption, sometimes by pushing a bony shell before it. The most important treatment is that directed against the original disease. This, with free drainage, will generally relieve the orbital lesions.

Periostitis and caries of the orbital walls cause orbital swellings, inflammation, abscess, and discharging sinuses. They must be treated as such lesions elsewhere, with especial care to keep up free drainage, and not to attempt the removal of dead bone, except after very careful study of the case, and through a free opening.

Osteoma of the orbit, or ivory exostosis, is a very hard, bony tumor, invading the orbit from the frontal or ethmoidal sinus, and sometimes also invading the cranial cavity. It appears at the upper inner angle, or the upper margin of the orbit, and grows very slowly, displacing the eyeball downward and usually outward, and for a long time continues painless. It should be removed as early as possible to forestall the danger of extension inward. There is little tendency to recurrence.

EDWARD JACKSON,
* Denver.

ORCHITIC EXTRACT. See ANIMAL EXTRACTS.

ORCHITIS. See PENIS AND TESTICLES, DISEASES OF.

OREXIN.—Orexin is chemically known as phenylidihydroquinazoline tannate— $C_{14}H_{12}N_2(C_{14}H_{10}O_9)$. It occurs as a yellowish-white, odorless, and practically tasteless powder, insoluble in water, slightly soluble in alcohol, and soluble in dilute hydrochloric acid. It is incompatible with preparations of iron.

THERAPEUTIC USES.—It is chiefly used to improve the appetite and as an antemetic, in doses of from 8 to 12 grains (0.5 to 0.8 Gm.), given in wafers, powder or in tablets, with a half-glass of water. It is indicated in **anorexia**, in the absence of gastric disease, to restore the appetite in **phthisis, chlorosis, cardiac disease**, and **after surgical operations**, etc. Its antemetic properties are utilized in the treatment of the **vomiting of pregnancy, seasickness** and the **vomiting following narcosis**. This remedy is contraindicated when hyperacidity of the stomach or gastric ulcer is present. W.

ORGANIC EXTRACTS. See ANIMAL EXTRACTS.

ORIENTAL SORE.—This disease, also known as Delhi boil, Aléppo boil, Biskra boil, Bagdad boil, **dermal leishmaniasis**, etc., is a specific, circumscribed, ulcerative affection of the skin caused by *Leishmania tropica* Wright. Many different diseases have been described under that name, among them the so-called Nile boil (of pyogenic origin), and the Bucharest boil, which have no connection with oriental sore.

SYMPTOMS.—After an incubation period varying from a few days to several weeks or months, marked by irregular attacks of fever, one or more itching spots may be seen on the skin of an uncovered part of the body (feet, legs, hands, arms, face), having the appearance of a mosquito-bite. These spots become red, shotty, and elevated, and are surrounded by an area of inflammation which later becomes indurated. These hard papules slowly enlarge

until they are the size of a pea or bean and their surface, previously smooth and shiny, becomes covered with small, thin scales. Ulceration of this nodule, beginning after not more than three or four months, is at first superficial, with a yellowish secretion which, however, soon dries into an adherent, hard, darkish scab, beneath which the ulceration slowly progresses, the nodule becoming disintegrated. The tissues about the ulcer may become the seat of edema. The ulcer is usually indolent, and but slightly painful. The neighboring lymphatic glands do not become enlarged unless by secondary pyogenic infection. The blood-picture shows an increase of mononuclears, while the leucocyte count may be normal or may show leucopenia; the coagulability of the blood is increased. The ulcers begin to heal by granulation after four to twelve months, leaving a whitish or pinkish scar, which is often depressed, and which may again break down.

The disease is not only spread by direct infection from man to man, but is also autoinoculable. It is conveyed by absorption of the virus through some breach in the skin surface (cut, scratch, wound, ulcer). Insects, especially flies, are probable carriers of the disease.

DIAGNOSIS.—The diagnosis is made from the fact that the patient comes from, or is living in, an infected area, from the natural course of the disease, from the non-enlargement of the contiguous lymphatic glands, and, finally, by the discovery in scrapings from the edges and floor of the ulcer of *Leishmania tropica*. Leishman's, Giemsa's, or any other Romanowsky stain will facilitate the discovery of the parasite.

PROGNOSIS.—So far as life is concerned the prognosis is good, although death may, though rarely, occur from phagedena, and from secondary septicemia and pyemia.

TREATMENT.—This is, as a rule, unsatisfactory and an expectant treatment is advised. After removing the scabs with boric acid fomentations, the ulcers are disinfected once or twice daily with a 1:1000 solution of mercury bichloride, or 2 per cent. phenol, and then dressed with an antiseptic ointment of betanaphthol,

iodoform, eucrophen, boric acid, or balsam of Peru. According to Lambert, effective treatments comprise tartar emetic intravenously, X-rays, freezing by carbon dioxide for superficial lesions, and in very early lesions, excision and cauterization. Castellani cured 7 cases with oleum phosphorum (B.P.) applied externally and in local injections (3 to 5 minims). S.

ORTHOFORM.—Orthoform is the methyl ester of para-aminomethoxybenzoic acid. It occurs as a fine, white, odorless, crystalline powder, neutral in reaction, slightly soluble in water, and easily dissolved in glycerin, in 5 or 6 parts of alcohol, in 50 parts of ether, or in water acidulated with hydrochloric, nitric, or acetic acid. It is feebly antiseptic. It possesses an anesthetic and analgesic action, like cocaine, but does not penetrate the tissues on account of its insolubility, and persists longer.

Orthoform hydrochloride occurs as a white, crystalline powder having an acid reaction, and soluble in 10 parts of water.

PREPARATIONS AND DOSES.—Orthoform is not official, but may be used in the following forms:—

1. The crude powder, either alone or mixed with equal parts of lycopodium, or milk-sugar, which should be accurately insufflated upon the required area, since orthoform takes effect only on contact and does not extend beyond. Internally it is given in doses of from 8 to 15 grains (0.5 to 1 Gm.) in emulsion.

2. Pastilles: Orthoform, 3 to 5 grains (0.2 to 0.3 Gm.); solution of cochineal, q. s.; saccharin, $\frac{1}{4}$ grain (0.015 Gm.); glycogelatin, q. s. These pastilles are useful in oral, tonsillar, and postpharyngeal affections.

3. Orthoform collodion: A saturated solution of orthoform in collodion. This is useful in ulcers exposed to much friction; but, as it causes acute smarting, it is advisable to anesthetize the ulcer first, either with cocaine or with orthoform in powder.

4. Spray: Orthoform, 5 grains (0.3 Gm.); alcohol and water, of each, 50 minims (3.3 c.c.). This is used in spray and is, perhaps, the best form for treating nasal and laryngeal ulcerations. The alco-

hol evaporates quickly after contact with the parts, leaving the precipitated powder evenly distributed over the affected area.

5. Ointment (10 to 20 per cent.), with lanolin.

6. Aqueous solution (10 per cent.) of the hydrochloride as a paint.

PHYSIOLOGICAL ACTION.—Orthoform is said by Kallenberger to be free from any toxic property, but this has not been found to be strictly true. When it comes in contact with sensory nerve-filaments it has a powerful anesthetic effect, which persists in some instances for three or four days; on account of this property it is an excellent dressing for **burns** or **painful ulcers**. An important property is its inhibiting effect upon secretion; in case of **carcinomatous ulcers** or of **transplantation wounds** the dressings remain so dry that they seldom require renewal.

Experiments by Soulier and Guimard showed that in the dog a dose, by mouth, of orthoform which exceeds 15 grains (1 Gm.) per kilo (2.2 pounds) of body weight is to be considered toxic. But warm, 1 per cent. solutions of orthoform, injected into the peritoneal cavity, produce toxic effects in the dose of $3\frac{3}{4}$ grains (0.25 Gm.) per kilo (2.2 pounds) of weight. The substance may, indeed, cause death in six minutes if it reach the dose of $7\frac{1}{2}$ grains (0.5 Gm.) per kilo (2.2 pounds).

The action of orthoform, after injection, is that of a powerful cerebrospinal nerve-depressant. Its local action, on the other hand, requires direct contact with the nerve-endings. Soulier and Guimard consider that orthoform is an *analgesic*, in the true sense of the word, rather than an anesthetic.

When orthoform is taken internally it is absorbed from the intestinal canal, and is eliminated somewhat changed by the kidneys. The urine does not readily undergo putrefaction during its administration.

POISONING BY ORTHOFORM.—Although orthoform is considered non-toxic it sometimes exerts an irritating effect upon the skin. It may cause erythema, alone or complicated with vesicles or pustules, and gangrenous eruptions. The former may appear even when the orthoform is applied upon healthy skin

without breach of surface. The gangrenous eruptions follow the treatment of varicose ulcers with orthoform.

Brocq reports a case in which the application of an ointment (1 to 40) to the face induced great swelling and marked redness, lasting nearly three weeks. In another patient use of the powder on a fissure of the vulva caused intense tumefaction, and nodular swellings in various parts of the body.

Asam observed a peculiar necrotic process appearing in the course of three to fourteen days after the application of orthoform to tumors, ulcerations, wounds, etc., and retrogressing when the orthoform was stopped. The first inflammatory stage of the process produced metastases in 6 cases, by reflect action or by the circulation, terminating in the necrotic stage. In the 9 cases reported orthoform at first produced its usual favorable effect. In numerous other cases in which it was used both internally and externally there were no unpleasant results from its use.

THERAPEUTICS.—Orthoform is chiefly used in **painful ulcerations of the upper air-passages**. It occasionally produces a slight burning for a few minutes after its application. It may replace cocaine when **prolonged anesthesia of ulcerated surfaces** is desired, cocaine being reserved to produce temporary anesthesia of an intact mucous membrane.

Orthoform gave Lichtwitz good results in **hay fever**, the powder being insufflated into the nasal cavities. In **faucial troubles** where there is no ulceration, but where the epithelial layer of mucous membrane has been denuded, the application of orthoform relieves the pain and reduces the inflammation. After **removal of the faucial tonsils**, if orthoform is applied to the cut surfaces the patients can eat solid food without pain, and the parts heal quickly. There is no pain after **removal of an elongated uvula** if orthoform is applied.

An emulsion of orthoform, 25 parts, and olive oil, 100 parts, has been used for **laryngeal** application chiefly in cases of **tuberculosis**. A distinct diminution in the amount of secretion in cases of ulceration is noted, but otherwise it does not appear to have any local therapeutic value. Patients do not dread the **lactic acid treat-**

ment if orthoform emulsion is used regularly.

Orthoform and arsenic (equal parts) have been used to make a painless paste to be applied as an escharotic in **epithelial cancer** and small **superficial growths** (1 part of the mixture to 45-70 parts of alcohol and water).

The drug is used as an application to **burns and painful sores**, applied in powder or ointment (10 to 20 per cent.).

Dressing **cracked nipples** with an alcoholic solution of orthoform brings about complete anesthesia during suckling and keeps the cracks aseptic. The infant is put to the breast a quarter of an hour afterward and sucks eagerly, as orthoform has neither taste nor smell. The anesthesia is absolute and persists for a considerable time.

Orthoform is an effective agent for the pains occurring **after the extraction of teeth with peridentitis**. It may be applied on a moist piece of cotton.

After **operations about the rectum, the urethra, and the sexual organs**, the intolerable pains, smarting, burning, or itching are relieved by the use of orthoform, as a powder, in the first dressing, its action lasting about twelve to twenty-four hours. Orthoform after **operations for the removal of hemorrhoids** has been used with satisfactory results.

Orthoform may be applied without danger to **ulcerations of the mouth, pharynx, and larynx**. It is also particularly useful as an analgesic in **dysphagia** due to **cancerous ulceration of the epiglottis or esophagus**. Two and a half grains (0.15 Gm.) in a cachet will ease the pharyngeal pains of **gastric ulcer** in five minutes.

By mixing 5 to 10 per cent. of orthoform with a 10 per cent. solution of **mercury salicylate**, the pain accompanying **intramuscular injections for syphilis** is prevented or relieved.

Orthoform has been combined with infiltration anesthesia in the following manner: An injection is first made after Schleich's method, which permits painless incision of the tissues. The anesthesia is then completed and rendered more profound and durable by powdering the wound with orthoform.

In **carious teeth with exposed nerve-**

endings a piece of cotton dipped into a saturated alcoholic solution of orthoform, packed not too tightly, will arrest the toothache in three or four minutes, and will maintain its anesthetic effect for several days if the packing is not removed.

Orthoform may be taken internally in doses of 8 to 15 grains (0.5 to 1.0 Gm.) as an internal anodyne.

Given in doses of from 15 to 20 grains (1.0 to 1.3 Gm.) per day, it has been asserted to relieve pain in **cystitis** and **gonorrhea**.

In affections of the stomach, about 3 knife-pointfuls of orthoform may be given in a glass of water. This is to be taken at a draught, and the patient should then lie in various positions successively, to insure contact of the mixture with the gastric wall at all points, unless any particular portion of the wall is the seat of pain, in which case he should lie in such a position as to bring about prolonged contact of the drug with the affected area. In **ulcer of the stomach** and in **carcinoma** (at the stage of ulceration) the analgesic effect is well marked. The drug is best administered on an empty stomach, and is especially efficacious after the organ has been washed out. W.

ORTHOPEDIC DEFORMITIES.

Orthopedics is that branch of surgery which deals with the prevention and correction of diseases and deformities of the bones and joints. In its fuller sense it may be defined as that branch of surgery which deals with the restoration of function of the motor apparatus of the body. Under the present heading the conditions dealt with will be mainly those which are the most commonly encountered, *viz.*, the orthopedic deformities of the lower extremities.

CONGENITAL CLUB-FOOT (TALIPES).

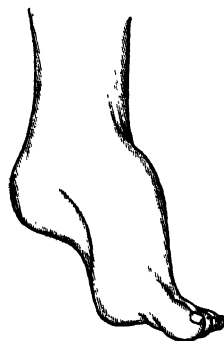
GENERAL CONSIDERATIONS.

—Club-foot is the name applied to a congenital deformity of the foot in which the foot is persistently displaced

from its normal position. This displacement is always in the direction of normal movement and is caused by the permanent contraction of one or more of the four main groups of muscles that control foot motion. If the calf muscles are contracted, the toes are displaced downwards, causing the patient to walk on the toes (*talipes equinus*). If the extensors are shortened, the patient walks on the heel (*talipes calcaneus*). If the tibial group is contracted, the sole of the foot is turned inwards (*talipes varus*), and if the peroneal muscles are shortened, the sole is turned outwards (*talipes valgus*).

In many cases there is present a combined contracture of a lateral and an anteroposterior group of muscles, causing a double deviation of the foot, the most common combination being the equinovarus type.

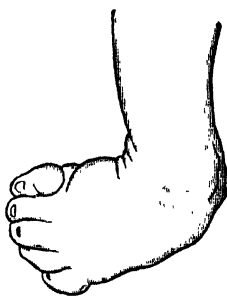
The muscle contractures are prenatal in origin, and are probably due to some injury or defect in the muscles themselves or in the nerves that supply these muscles. Before weight-bearing occurs the deformity is purely one of the soft parts, but bony deformity of the foot and lower leg quickly follows after walking begins. On this account it is of the most vital importance that the diagnosis be made early, that treatment be instituted immediately, and that the deformity be entirely corrected before bony distortion takes place. If the treatment is instituted immediately after birth and is faithfully carried out, complete restoration of function may be looked for. If, however, treatment is delayed until bony deformity has occurred, operative measures become necessary, and perfect function cannot be restored.



Equinus.



Calcaneus.



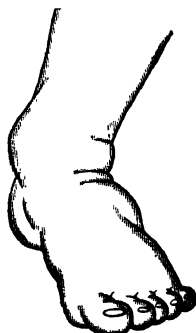
Varus.



Valgus.



Equinovarus.



Equinovalgus.



Calcaneovarus.



Calcaneovalgus.

Varieties of compound club-foot. (McCurdy.)

TALIPES EQUINOVARUS.—

This is the most common congenital deformity, 80 per cent. of all club-foot cases coming under this heading. In the equinovarus deformity the calf and tibial groups are contracted, and the sole of the foot is drawn inwards and the heel pulled upwards. The diagnosis is easy, and should be made immediately after birth.

Treatment.—This should be begun as soon as the diagnosis is made. In infants under three months of age the main reliance must be placed on **manipulations** or **stretchings**. The stretching consists in endeavoring to replace the foot in its normal position by manual force. This may be done by the mother or nurse six times each day, each treatment requiring five minutes. The following is the method used: The leg is grasped close to the ankle-joint by the left hand; the anterior part of the foot is grasped in the right hand and twisted or rotated outwards so as to overcome the varus deformity. This having been done, the foot is dorsiflexed on the leg so as to stretch the tendo Achillis. In other words, the foot is twisted outwards until the ball of the first toe is in line with the inner malleolus and the side of the leg, and then flexed on the leg to bring down the heel.

On completion of the stretching a **flannel bandage** may be applied to the foot to help maintain the corrected position, and in the older infants the bandaged foot may be placed on a **right-angled splint**. The splint should be well padded with felt or wool and the foot firmly bandaged to it.

As the child increases in size, manipulation followed by **plaster-of-Paris cast** to hold the foot in the corrected

position may be tried. In the application of such a cast the foot and leg should be well protected by felt or flannel and the plaster applied with great care to prevent too great pressure on the foot or leg. While the plaster is setting the foot must be held in the correct position, and after application the foot must be carefully watched to see that the cast is not too tight. The toes constitute a good guide: If these are pink, and not blue and swollen, one may be assured that the circulation of the foot is satisfactory. Repeated applications of the plaster-of-Paris bandages, at three or four week intervals, will cause much improvement.

If the deformity persists the question of **tenotomy** will arise. In very young infants it is better not to resort to tenotomy at once, but in older children and in those in whom the deformity is very resistant, tenotomies are to be advised. Usually subcutaneous **section of the tendo Achillis** at its insertion into the os calcis will be sufficient. In the very stubborn cases, **section of the anterior tibial and of the plantar fascia** is necessary. After tenotomy the foot must be held in the overcorrected position by **plaster cast** for at least four weeks.

The following procedure for cases seen in the newborn is described by Allen: Immediately after birth place strip of **zinc oxide adhesive plaster** over sole and inner aspect of foot, **over-correct position** of latter, and draw plaster tightly along outer aspect of leg. Place second strip over sole just posterior to base of metatarsals, extending over inner aspect of foot and ending over joint of great toe. Draw firmly, apply to outer side of leg, 1 to 2½ inches above external malleolus, and wrap around leg in an ascending spiral. Place further strips to cover and tighten the second tension strip, beginning on leg 2 inches above ankle and

overlapping until instep is reached. Renew dressing after cleansing foot with ether and alcohol, 10 days or 2 weeks later. Deformity will be corrected in 6 or 8 weeks. Leave foot with **stiff-ankle infant-shoe**, with one strip of adhesive on outer side of foot and leg.

The treatment of congenital club-foot must begin from the moment of birth, when the structures in the foot are soft and pliable, and little pain or shock is experienced by the infant. The aims in treatment are to stretch the contracted structures causing the deformity and to relax and then educate those muscles which will restore the muscle balance of the foot. **Splinting** with malleable iron, **adhesive strapping**, **plaster-of-Paris**, club-foot **tin shoes**, and **operation**, *e.g.*, with the **Thomas wrench**, are procedures generally employed. In cases seen early the prognosis is excellent; in neglected and "relapsed" cases, and in children already operated upon, it is fair. In cases with stubby heels, talipes calcaneovalgus, or simple midtarsal varus, the results are less satisfactory. B. W. Howell (*Brit. Med. Jour.*, June 6, 1925).

In all these methods of treatment, the deformity must be overcorrected. After this overcorrection has been obtained, a permanent **brace** must be applied to prevent relapse. The most common apparatus is a shoe laced down to the toe, fastened to two side-irons extending upwards to the calf and held by a leather cuff. An elastic band extends from the outer side of the shoe at the level of the fifth toe to the upper end of the brace. A strap passes over the instep to keep the heel firmly pressed to the sole of the shoe. In applying this brace the shoe must be entirely unlaced and the foot held firmly to the sole of the shoe while the instep strap is being tightened. This brace should be removed daily for further manipulation of the foot, and must be worn at

night as well as during the day. It must be used for at least a year after the child learns to walk.

Description of a device useful in the correction of club-foot, as well as flat-foot and fractures or luxations causing foot deformity. It is especially of service where no trained assistants are available. Plaster is first applied from the ankles to the knees; then, with the legs slightly apart, the 2 plaster dressings are bound in front to a crossbar by a figure-of-8 bandage reaching above the ankle. The bar projects several centimeters on both sides. The plaster dressings having hardened, the feet are straightened, padded as required, and plaster bandages then carried to them from the leg over the crossbar. Any needed position of abduction, adduction, pronation, supination or dorsiflexion of the feet is thus obtainable. The dressing is easily maintained, and the feet are not entirely covered, thus more easily avoiding sores and facilitating inspection. Elastic bandages, to be renewed frequently, may be substituted for the plaster dressings when desired. O. Roith (*Deut. Zeit. f. Chir.*, May, 1924).

In children in whom the deformity persists after weight-bearing has begun the above types of treatment may prove successful in the milder cases. In the majority of cases, however, they will prove insufficient, and operative procedures must be resorted to to correct the bony defects. The most commonly employed operation is that of **wedge-shaped resection of the tarsus**. This is done by making a curved incision over the anterior part of the os calcis, the cuboid and the head of the astragalus and removing a wedge from the anterior portion of the tarsus, the base of the wedge pointing to the anterior external surface. This wedge must be large enough to allow easy

replacement of the foot in its normal position. The foot is to be held in a **plaster cast** for at least six weeks following the operation.

Another successful procedure is that advised by Hoke, in which the **head of the astragalus is remoulded** so that it may take its normal alignment with the scaphoid. At the same time the joints between the astragalus and os calcis are subjected to **arthrodesis** to prevent further lateral deformity. This operation is also followed by plaster cast and post-operative bracing.

Out of 66 orthopedic surgeons corresponded with, 90 per cent. favored starting treatment for congenital equinovarus within the first month of life, and $\frac{3}{4}$ of these within the first week. All **manipulated** the youngest patients at first, and the majority used **plaster** for fixation. When the age limit was 6 months, 14 used **tenotomy** for severe cases, 12 for resistant Achilles tendon, and 3 if the condition were moderately severe; 28 never operated, and 3 but rarely. Forceful **correction under anesthesia** was used by 19 for extreme cases and 7 for most cases, while 36 were against the procedure. The majority used **braces** for retention but not for correction. E. W. Fiske (*Jour. of Orthop. Surg.*, Dec., 1921).

TALIPES EQUINUS.—This is one of the more rare congenital deformities. It is often seen, however, in the acquired types, especially after infantile paralysis. It is caused by contracture of the tendo Achillis with resulting plantar flexion of the foot. The diagnosis is easily made on the basis of the persistent deformity.

Treatment.—The treatment should be instituted as early as possible. It consists of **manipulation** and **stretching of the tendo Achillis** in the mild cases, and subcutaneous **tenotomy** of the tendon in the more severe cases.

In the very severe types of this deformity it may be necessary to tenotomize the flexor tendons on the plantar surface of the foot. A **walking brace** to prevent recurrence of the deformity should be worn for at least a year.

TALIPES CALCANEUS.—This is likewise one of the uncommon congenital deformities. It is caused by contracture of the extensor (dorsiflexor) muscles of the foot. This contracture causes the patient to bear weight on the heel only.

Treatment.—The deformity is usually mild in character, and can be corrected by **manipulation** and held by some type of **brace** which will prevent heel walking. In the persistent untreated types, operative procedures may occasionally be necessary. These operations are the same as those used for the acquired type of calcaneus seen in infantile paralysis.

TALIPES VARUS and TALIPES VALGUS are rare conditions and are usually amenable to **manipulation**. The severe and persistent cases of valgus deformity are treated by the same methods as are used for the correction of the acquired types of flat-foot.

Infants, on beginning to walk, frequently develop a talipes valgus. In this event they should be kept off their feet for a few months by fitting a pair of light wooden **internal splints** extending below the feet, held in position with straps and buckles, the lowest strap passing around the foot and holding it well adducted. When walking is permitted, the shoes should have the inner borders of the soles thickened by $\frac{1}{8}$ inch and the splint should be continued at night. G. Percival Mills (Pract., May, 1922).

FLAT-FOOT (PES PLANUS; PES PRONATUS).—Flat-foot consists in the flattening of the arch of

the foot. It is usually preceded and accompanied by pronation of the foot. Pronation is caused by weakness of the muscular supports of the arch, with stretching of the muscles and, in the later stages, of the fascial supports. Any general or local condition, such as debilitating illnesses, sudden increase in body weight, overuse, poor shoeing, etc., which causes undue strain upon the tibial muscles will bring about this condition. It is seen more commonly in children and adolescents, and more often in females than in males.

Symptoms.—Subjective symptoms are pain, usually occurring in the arch and radiating upwards to the calf, the inner and anterior side of the leg, and at times extending to the knee, thigh, and lower part of the back. The symptoms are increased by prolonged weight-bearing and relieved by rest. They vary greatly in individual cases, and are not necessarily proportionate to the amount of physical defect.

Objectively, there is usually tenderness in the arch and over the prominence of the scaphoid. There is no deformity of the foot until weight-bearing occurs. At that time the foot assumes a mild valgus position, the internal malleolus and the scaphoid becoming prominent. The arch of the foot is usually obliterated to some extent. In the more advanced cases the arch becomes entirely flat and does not return to its normal position when weight-bearing ceases.

A diagnosis of flat-foot in children should not be made inconsiderately, according to Ehrenfried. In 327 out of 440 cases, the foot symptoms were secondary to some other condition, which required treatment. Continued observation in many apparently simple cases showed mild rickets or unsuspected infantile paralysis; less often, such

conditions as tuberculosis of the knee, hemiplegia, lead, postdiphtheritic, or spastic paralysis. Some are congenital and should more properly be classed with club-foot. Some show evidence of muscular insufficiency resulting from physical debility, which is frequently the sequel of an infectious disease. Prophylaxis of foot disabilities consists in combating 2 important causes, *viz.*, rickets and the infectious diseases of childhood.

Flat-foot is a possible cause of synchronous pain in the sacroiliac joints, with relaxation of the latter. Magnuson remarked that: "Probably more women have been operated upon for pelvic trouble because of flat-foot and flat back, than on account of any other poor diagnosis we have made." W. H. Palmer (*Intern. Jour. of Surg.*, xxx, 199, 1917).

In falling of the arch, the writer found malposition of the cuneiform responsible in the majority of cases; of the cuboid in the next greatest number, and of both bones in the remainder. The resulting pain, from impingement on nerves, is often as severe as in metatarsalgia. Inflammation and adhesions follow. In the treatment, **rupture of adhesions** is effected by frequent application of firm pressure over the plantar surface of the misplaced bone, the foot being held firmly and a sharp blow delivered over the dorsal surface of the metatarsals near the base with the palm of the right hand. This is followed by **deep massage**, which is essential to build up the natural arch and prevent recurrence. W. T. Clark (*Med. Rec.*, May 28, 1921).

Treatment.—The **general health** must be **attended to**, and any **exciting cause**, such as overwork or improper shoeing, **corrected**. General muscular tone must be built up by **tonics** and **general hygienic measures**.

Locally, the foot deformity must be corrected by proper **shoes** and **supports** and by **exercises** to strengthen the tibials. In any case the type of shoe worn is of the utmost import-

ance. It must have a straight last, a stiff shank, and must fit the heel snugly. It should be three sizes longer than and as wide as the weight-bearing foot. In mild cases, raising of the inner side of the heel from $\frac{1}{8}$ to $\frac{1}{4}$ inch will tend to correct the pronation. In more advanced cases the addition of some sort of **arch support** is indicated. The author believes that the soft, resilient types of support give more benefit than the rigid types. In either case the support must be accurately fitted to the individual foot. This is best done by taking a mould of the foot of plaster-of-Paris and making the arch support over this mould.

In weak or flat foot the patient should **walk with the feet parallel**. **High laced shoes**, with the **inner sides of the soles and heels raised** $\frac{1}{4}$ inch in average and $\frac{3}{8}$ inch in severe cases, are ordered by the writer. These alterations should be inspected before the shoes are worn, as cobblers are careless. Even for children, $\frac{1}{4}$ inch raise is not too much as a routine measure. To strengthen the muscles and ligaments that hold up the arch, the following simple **exercises** are of value: (1) Inverting the feet while standing, or balancing upon the outer edges of the feet; (2) rising upon the toes and then slowly coming down upon the outer edges of the feet to the outer edges of the heels. These exercises should be done as often as possible. Exercises performed while sitting often do little good. The foregoing measures give prompt relief to all but the most acute cases of arch strain; the latter are better off in **bed** till the acute symptoms subside. **Arch supports** are not curative, and only sometimes palliative; they are generally worn far too long. Some patients advanced in years, with arthritis, will not tolerate the changed line of weight-bearing which results from raising the inner sides of the soles

and heels, and are better off with **soft pads under the arch** to distribute the weight on the tender feet. McChesney (Cal. State Jour. of Med., Oct., 1922).

In all cases **muscular exercises** to increase tibial power must be used over long periods of time. In the more acute cases, **strapping of the foot** with adhesive plaster with the foot held in mild supination will give great temporary relief. In cases in which there is no marked contracture of the peroneals or of the tendo Achillis, these may be **tenotomized**. Hoke advises the **ankylosis** of the scaphoid and internal cuneiform joints to prevent dropping of the arch. In cases of rigid flat feet in which the deformity cannot be corrected, **manipulations under ether** and correction by **plaster-of-Paris casts** are of value as a preliminary to the above-mentioned treatment.

The following exercise for the treatment of flat-foot, restoring 90 per cent. of the men to ranks cured, was practised at Fort Ethan Allen. Shoes and stockings are removed. The men stand on a raised platform, a 2-inch plank is sufficient; they are then directed to flex the toes to the extreme point of flexion with a hard pull of the flexor muscles of the sole at the extreme point of flexion. This is followed by extension without effort. This is repeated continuously from 5 to 10 minutes, with the shorter period at the beginning, and the period gradually lengthened until the full time is possible without fatigue. The second exercise is a continuation of this flexion of the toes on the sole of the foot, plus inversion of the foot to the extreme, bringing into the action the tibialis anticus muscle. At the extreme point of inversion a *strong, hard pull is made*, then the foot is allowed to resume its usual position without any muscular effort.

At the beginning, 15 or 20 minutes

are sufficient for the exercise. Later, after the muscles become stronger, a full half-hour may be devoted to this. The plan is carried out each morning. The patients repeat this performance each night on retiring, devoting $\frac{1}{2}$ the time consumed in the morning. Many of the cases are found to walk with the toes turned out. They should walk with the toes turned in at all times. Lieut. H. B. Berry (Month. Bull. N. Y. State Health Dep., Med. Rec., Feb. 16, 1918).

The writer has the patient walk in moccasins under the soles of which, behind the ball of the foot, are attached **rounded wooden blocks**. The obstacle to the usual gait should be sufficient to furnish adequate foot-muscle exercise. Bradford (Inter. Jour. of Surg., Dec., 1920).

Shortened tendo Achillis emphasized as a frequent cause of weak and flat feet. Out of 50,000 soldiers, 12 per cent. had heel tendons which would not permit dorsiflexion of the foot beyond a right angle. In walking, the heel is lifted from the ground as the body swings forward, or if it remains on the ground, the foot is rotated outward, throwing strain on the inner side of the foot. The treatment is subcutaneous **tendon lengthening** by partial resection at different levels, or, after the age of 35, **elevation of the heel** of the shoe or the use of a **pad** under the heel inside the shoe. Another condition predisposing to weak or flat foot is *hypertrophy of the inner end of the scaphoid*, and a third, a *supernumerary tarsal bone* at the inner side of the scaphoid, over which runs the tendon of the tibialis posticus. The best treatment is **removal of the supernumerary bone and the inner end of the scaphoid**, and **reattachment of the tibialis posticus** further forward on the scaphoid or even to the internal cuneiform. Rugh (Ann. of Surg., Apr., 1921).

E. Moser's method of treating *spastic flat-foot* is approved by the writer after using it in 24 severe cases. It consists in injecting 10 c.c. (2½ drams) of a 0.5 per cent. solution of **procaine**

into the peroneus muscle, and the same quantity into the extensors. Engelmann (Wien. klin. Woch., May 29, 1924).

METATARSALGIA (MORTON'S TOE; FALLEN ANTERIOR ARCH).—This condition is usually secondary to weakness in the main arch of the foot. The immedi-



Adolescent knock-knee. Deformity most marked in the tibiae. (*Whitman: "Orthopaedic Surgery."*)

ate cause of the symptoms, however, is the relaxation of the transverse arch. The condition is seen almost entirely among adults, and is more common in females than in males. Subjectively, the symptoms are dull pain on weight-bearing under the heads of the 2d, 3d, or 4th metatarsal heads. This pain often radiates forwards to the toes. At times the pain is very spasmodic, and sharp and cramp-like in character—this type

being the one first described by Morton. In addition to pain there is usually marked callus formation under the metatarsal heads. These heads may be felt more plainly than normally, close to the plantar surface of the foot.

Treatment.—The treatment consists of relieving any general or local exciting cause. Locally, some type of **support** that will give support to the 2d, 3d and 4th metatarsals will in most cases give relief. This support should be of some firm resilient material, such as felt, ovoid in shape, about $1\frac{1}{2}$ inches long by 1 inch broad and $\frac{3}{8}$ inch high, placed immediately behind the heads of the affected metatarsals and fixed to the sole of the shoe in that position. The shoe itself should be of the same type as that used in flat-foot, and should be snugly fitted laterally.

In addition to support, **exercises**, such as flexing the toes while standing with the toes projecting beyond the edge of a board, or attempting to pick up small objects such as pencils or marbles with the toes, are of great value. Only in the most stubborn cases is operation advisable. In these, **resection of the metatarsal head** which is at the point of pain may be carried out.

KNOCK-KNEES (GENU VALGUM).—In this condition the legs, instead of being in line with the thighs, are inclined outwards at the knee-joints. This causes the feet to be more separated than normally and the knees to be closer together.

The deformity is caused either by abnormal laxity of the internal lateral ligament of the knee-joint or by an increased obliquity of the lower articular surface of the femur. In the first

type, the lax internal ligament allows abnormal abduction at the knee-joint, which is noted when the patient is weight-bearing and which disappears when the patient is at rest. In the second type, the internal condyle of the femur projects downward farther than does the external. This projection is on the inferior, but not on the posterior, surface of the condyle. Therefore, the deformity shows only when the legs are extended on the thighs. In this position, the deformity is persistent, and cannot be corrected in either the weight-bearing or non-weight-bearing position.

Etiology.—The causes of knock-knee deformity are malnutrition, muscular weakness, or rickets. When malnutrition and weakness are the causal factors, the deformity is usually of the first type, *i.e.*, that attended with relaxation of the knee ligaments. If this type is allowed to persist, bony changes in the internal condyle may occur and the second and more persistent deformity may result. Pronation of the feet is a very common defect due to muscular weakness, and this defect plays a major rôle in causing the relaxation of the knee ligaments. When rickets is the primary factor, the bony changes take place at a much earlier stage.

Symptoms.—Subjective symptoms are usually lacking in this condition, and for this reason the deformity is overlooked until the amount of deviation is severe. Diagnosis is not difficult, however, if the patient is examined with the legs extended in both the weight-bearing and non-weight-bearing positions.

Prognosis.—The prognosis is not as favorable as in the bow-leg deformities, since knock-knee is not as apt

to improve with growth; nor does it respond as readily to treatment. On this account, corrective measures must be thorough and must be instituted as early as possible.

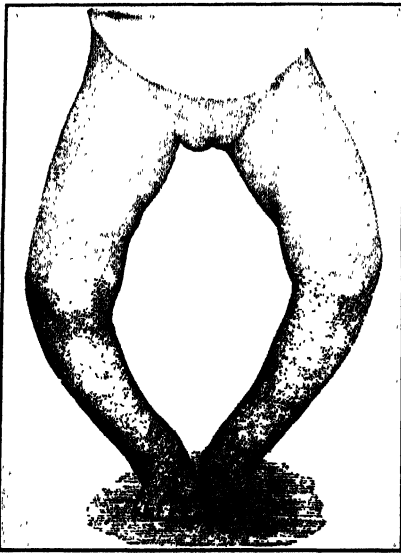
Treatment.—In the first type, the correction of the underlying muscular and nutritional defects will usually give satisfactory results. The **general constitutional condition** of the patient must be **attended to**. Good hygienic surroundings, a well rounded-out diet, and **tonics** such as **codliver oil** are most important.

The **overcorrection of pronated foot deformities** is of vital importance in the treatment of the knee condition. In the moderately severe cases, a corrective **brace** will often give good results. This brace usually consists of two leg-irons extending from the shoe to the upper thigh and jointed at the knee and ankle. The outer leg-iron is usually attached to a waist-band. At the inner condyle and external malleolus, pressure pads are placed, and the amount of pressure is increased by bending the leg-irons from time to time as the legs straighten.

When the deformity is marked or the parents are unable to give the case proper care, operative correction of the deformity is advisable. The operation used is division of the femur just above the lower epiphyseal line by subcutaneous **osteotomy**. The osteotomy is done on the external surface; the bone is cut through about two-thirds of its thickness and the remaining bone then bent or fractured by manual pressure, set in correct alignment, and held in position by a **plaster-of-Paris cast** extending from the costal margin to the toes. The cast is allowed to remain until full callus formation occurs.

In rachitic genu valgum, the writer slowly models the knee, gradually forcing it into the normal shape, in from 6 to 10 months. The plaster used holds the correction gained at each sitting, and is renewed each time, i.e., at intervals of 2 to 3 weeks. He manipulates the joint so gently that anesthesia is not required. The correction is perfect and continuous. Crainz (Policlin., Aug. 21, 1922).

In *genu recurvatum* (hyperextended knee), the writer uses a **modified**



A type of deformity in which the prognosis as regards outgrowth is bad. (*H'itman*: "Orthopaedic Surgery.")

Edwards operation for reconstruction of the lateral ligaments. Instead of constructing bands with attachments at the normal sites of attachment of the lateral ligaments, he secures the femoral attachment as far posterior on the femoral condyles as possible, as well as on the medial side to obtain an anterior attachment on the tibia. C. H. Heyman (Jour. of Bone and Joint Surg., July, 1924).

BOW-LEGS.—In bow-legs the concavity of the curve is on the inside instead of the outside of the limbs. Thus, the knees are unduly separated, instead of the feet. The bending,

furthermore, is commonly more gradual instead of angular, as in knock-knee.

The causes are much the same, but the affection usually occurs between the ages of 1 and 6 years, and less frequently in older subjects. It is more commonly, also, of distinct rachitic origin. The deformed appearance of the limbs of the patient is so marked that it is less apt to be overlooked than is the case with knock-knees. In the latter affection, as has been said, a position of valgus is often assumed by the foot. This is turned so as to enable the sole to be placed flat on the ground. In bow-legs the sole has a tendency to incline inward, so that in order to bring the sole flat on the ground the feet are widely separated. Thus, the feet are very far apart as well as the knees, and this gives a peculiar appearance to the patient, which is at once remarked by the parents. In-toeing is also present.

The bowing may involve the tibia and fibula alone, or the femur in addition. The knee-joint itself is not often affected. The curve is not always a lateral one, but may be in an anteroposterior direction, often combined with lateral bending.

Treatment.—The line of treatment to be pursued depends upon the age of the child and the extent and character of the deformity. As the nutrition of the patient is almost always at fault, particular attention should be paid to it. As it is evident that the child has not grown satisfactorily on its previous feeding and mode of life, the usual diet should be **changed** and the child be gotten out in the **open-air** as much as possible, and **codliver oil** and **hypophosphites** given internally or **codliver oil rubbed thoroughly into the skin** every day.

In endeavoring to straighten the limbs by non-operative mechanical means, the child may either be kept abed or allowed to walk around. If it is desired to obtain the greatest possible correction in a short time, the child is to be kept in **bed** and the **limbs bandaged** to each side of a **splint** placed between them. When the curvature is confined to the bones of the leg, a very efficacious method is the following, devised by Davis: A pad is placed between the **ankles**, and these are then firmly **fastened together** with a **bandage**; another pad is placed between the **knees**, and they likewise are **bound** firmly **together**. The legs are then covered with a plain muslin bandage, and directly across from one leg to another at the point of greatest curvature is placed a **rubber bandage**. This, by its continuous pressure, tends to obliterate the curve. Care should be taken not to apply the rubber bandage too tightly.

If the child is to be allowed to walk around freely, **braces** must be employed. These are often made of a single inside bar. This form, however, is not so firm, nor does it make so efficacious pressure as does a double brace. It is best to have a **brace** made **with two side-irons jointed** at the **ankle** and **knee**. A pad is placed over the inside of the ankle, another at the knee, and a third on the opposite side of the leg. By bending the apparatus every few weeks any desired degree of pressure can be obtained. It is highly desirable to carry the apparatus above the knee, so that rotation be prevented. A fairly efficient apparatus for very young children can be made without any ankle-joint, as it is hardly so essential in them as in adults.

In bow-legs, if the child is under 2 years of age, and the mother intelligent, the writer recommends the use of **braces**. If over 2 years, he advises **osteoclasis** or open **osteotomy**. For some years he has been using a **short leg brace** with an inner iron extending from the inner tuberosity of the tibia down to the heel of the shoe, where it is bent at right angles to fit into a metal cylinder built in the heel. To this is attached a wide leather flap, which is laced, pressing the tibia toward the inner bar. In 1 to 1½ years the brace straightens the limb. The shoes are then constructed to prevent recurrence by building up the sole ¼ inch on the outer side. G. H. V. Hunter (L. I. Med. Jour., Feb., 1922).

In more stubborn cases subcutaneous **osteotomy** of the **tibia** may be utilized. This osteotomy should be performed at the apex of the curvature. The bone should be divided through about three-fourths of its thickness and then bent or fractured by manual pressure. The bone is thus accurately broken at the desired spot without undue violence. It is then set in the corrected position, and held by **cast** until healing occurs.

In cases of *anteroposterior curvature*, an **apparatus** with two **side-irons** and a **pad** strapped over the projecting bone and fastened to the side-irons is of service, but the results are not as good as in lateral cases.

In young children with soft bones, correction can be effected by **manual force** and the limb placed in a **plaster-of-Paris dressing**.

It is very often necessary to resort to a **wedge-shaped resection** of bone; this is an operation of considerable gravity, and the utmost care must be taken to employ a reliable aseptic technique.

HALLUX VALGUS.—This is a displacement of the great toe outward;

it is usually associated with enlargement of the bursa and tissues on the inner side of the metatarsophalangeal joint. In its most marked condition the cause is usually rheumatism or rheumatoid in nature, although severe cases occur even when no other symp-

spring fastened to a sole-plate and made by the surgical-instrument maker. Radical treatment consists in **excising the hypertrophied and inflamed tissues** over the projecting part and **removal of the head of the metatarsal bone**. Care should be



Skiagram of a foot modeled to fit the incorrectly shaped shoe, illustrating the etiology of hallux valgus. (*Whitman: "Orthopaedic Surgery."*)

toms pointing to those affections exist. Trauma and focal infection, with the tonsils as frequent sites of the latter, are important causes.

Treatment.—Conservative treatment may be tried, with a small **internal lateral splint** of covered metal to which the toe is drawn over by adhesive plaster or by means of a metal

taken not to remove too much, or a flail-joint may be left and walking interfered with. For this reason it is preferable not to remove both articular surfaces. The joint can also be straightened by removing a wedge of bone just behind it and transplanting the long extensor tendon more to the inner side.

The pain in bunion is probably due to involvement of the internal collateral nerve in the bursa, and can be relieved by simple **excision of the bursa** and of the **metatarsal head**, without, however, greatly improving the deformity. Massart (Bull. Soc. anat. de Paris, Feb., 1922).

The cosmetic failure in most cases operated for bunion is due to the continued distorting line of pull of the extensor hallucis muscle, the tendon of which, inserted at a distal point on the toe, acts like a bowstring. In operating, the writer makes an **elliptic incision** over the bunion, prolonged somewhat along the great toe. He severs the **tendon of the extensor hallucis** above its insertion, frees it to a point above the metatarsal head, and **implants it on the medial side of the base of the first phalanx**, thus establishing a more favorable line of pull. In cases with decided deformity, he also **excises a wedge** from the base of the first phalanx. As a dressing he uses a U-shaped **wire splint** with the loop of the U passed between the great and second toes and the ends fastened along the foot with plaster. Opposite the operated area a band of plaster joining the wires exerts a lateral pull on this area, holding the structures over-corrected until healing occurs. P. W. Roberts (Jour. Amer. Med. Assoc., Feb. 24, 1923).

Osteotomy of the metatarsal bone has been done, but it is effective only in comparatively mild cases.

A flattened arch aids in the production of hallux valgus by altering the line of pull of the extensor proprius hallucis. The preventive treatment of hallux valgus consists in developing a heel-and-toe walk with parallel feet, and in wearing anatomically correct shoes. The mechanical treatment consists in deflecting the body weight from the inner to the outer side of the foot and in relieving the painful joint from pressure and friction. **Operations** for correction of deformity in cases without functional debility should not be undertaken lightly, and never

unless the patient is prepared to wear appropriate shoes. For mild cases without symptoms when the deformity can easily be rectified without force, it is sufficient to **divide the capsule and reef it to the inner side, divide the extensor proprius hallucis, and remove a flap of skin** so that when the edges are approximated it will hold the toe in slight abduction. Where there is neither pain nor disability, but deformity cannot be rectified by manipulation, it may be necessary to expose the joint, **divide the tightened structures** on the outer side, **divide the extensor proprius hallucis**, and do a **cuneiform osteotomy** on the inner side. Where the symptoms are entirely referable to the **bursa**, the latter should be **excised**, together with the bony prominence below.

Removal of the head of the metatarsal should be reserved for extreme cases where the head is rough and painful and the joint tender. In the young athlete, as much as possible of the metatarsal should be retained, in order to maintain the strength of the arch. The incision through the bone should be oblique, and a portion of the lower surface of the head left. In cases where the symptoms seem to be maintained by friction of the first phalanx with the metatarsal, **excision of the base of the first phalanx** may suffice. Where symptoms resemble metatarsalgia and pain is referred to the space between the first and second metatarsal heads, there is often an osteophyte attached to the neck on its under surface and requiring removal. R. Jones (Brit. Med. Jour., Oct. 11, 1924).

Shrinking of the joint capsule induced by improper shoes is the main cause of that type of hallux valgus met with in weak or hypoplastic subjects. In 27 such patients the writer has resorted with success to an **excision of the ligaments of the capsule** on the lateral aspect. Another type of case is the arthritis type; in this group **osteotomy** is required. In severe deforming arthritis **arthroplasty** may be necessary. Correct shoes are essential

for the prevention of recurrence. The old shoes worn by the patient must be discarded. E. Payr (Zent. f. Chir., Oct. 10, 1925).

HALLUX RIGIDUS.—In this condition, also known as *hallux flexus* or *painful great toe*, there is restriction of motion at the proximal joint of the great toe, with the toe sometimes fixed in a position of slight flexion. The joint feels stiff and occasions pain, especially on standing or walking, and may appear somewhat enlarged and congested. Hallux rigidus is commonly an accompaniment of a weak or broken-down foot, sometimes with the prejudicial influence of improper footwear as an added factor. Occasionally it is due to trauma or a

Hallux rigidus develops in persons with slightly pronated feet and is due to extra strain on the great toe joint. Lipping of the joint cartilage causes pain in walking. The flexor brevis hallucis contracts to relieve the symptoms, and finally the contracture results in hallux malleus. In hallux valgus and these other conditions an important factor is luxation of the extensor proprius and flexor longus hallucis, the pull of which causes spreading of the metatarsal heads. Treatment should include **restoration of muscle balance; transplantation of the abductor hallucis** has proved beneficial. It may be necessary to **shorten**



Hammer-toe, hallux valgus, and flat-foot. (Whitman: "Orthopaedic Surgery.")

strain of the joint. In elderly subjects painful great toe, with restriction of dorsal flexion, seems at times to be a manifestation of gouty or rheumatic disturbance, though local treatment, according to Whitman, proves essential for its relief.

Treatment.—In the form combined with weak foot, the measures employed for the relief of the latter will generally also overcome the pain in the great toe. In both these and other types of cases, the pain may be prevented by using a shoe with an extra **thick sole** or provided with a longitudinal **steel splint**. **Overcorrection** under anesthesia, followed by retention in a **plaster bandage**, is in order where hallux rigidus and rigid flat-foot coexist. Where the affected joint shows hypertrophic changes, as in some of the cases among the older group of subjects, **excision** of the hypertrophied **end of the metatarsal bone**, with interposition of a flap of the joint capsule between the bones, is of service.

the first metatarsal. Painter, in hallux rigidus, uses either **custom-made shoes** to avoid pressure over the joint, with a **plate with steel tongue** the width of the great toe on its plantar surface, or, in the cases without dorsiflexion, **chiselling away of the ridge on the dorsum of the metatarsal**, or a regular **Hüter operation**. M. Jansen (Jour. of Orthop. Surg., Mar., 1921).

HAMMER-TOE.—This is a permanent contracture of one or more of the toes, usually of the second, in which the proximal phalanx is dorsiflexed; the middle phalanx, plantarflexed, while the third might be overflexed or extended. The deformity is due to contraction of the extensor and flexor tendons of the toe, and is usually secondary to some type of foot-

strain. There is usually marked corn formation over the projecting knuckle on the dorsal surface. This is usually very painful, and it is for this pain that the patient generally comes for relief.

Treatment.—In very mild cases, **division of the extensor and flexor tendons** of the deformed toe, followed by **correction of the foot-strain** causing the deformity, will often give relief. In moderately severe cases, **transplantation of the extensor tendon** from the phalanges to the head of the metatarsal bone, plus **division of the flexor tendon**, will give very satisfactory results. In the more severe and prolonged cases in which the capsules of the phalangeal joints have become contracted, or in which there is true bony deformity, **resection of the joint** between the proximal and middle phalanges gives the best result. This shortens the toe, but allows it to take its normal position. In the past, amputation of the toe was advised. This, however, produces a gap in the toe-line, and valgus deformity will almost surely follow sooner or later. Amputation, therefore, should never be recommended for this condition.

In all cases of hammer-toe the **causal factor** should be diagnosed, and this condition carefully **corrected** to prevent recurrence of the deformity.

Removal of the second toe in hammer-toe is likely to be followed by hallux valgus. In one of his cases the author merely **divided the extensor tendon**, resected the interphalangeal joint by a **wedge-shaped excision**, and applied a **padded plantar splint**, the whole being done under local anesthesia. The toe remained short but straight. P. G. Skillern, Jr. (Internat. Clin., ii, 69, 1921).

CLUB-HAND.—This term is applied to a rare condition of the hand corresponding to club-foot. It may be congenital, as a result of defective development, or may be caused by any traumatism capable of inducing paralytic contraction. The congenital variety is usually associated with deformity of the lower end of the radius or ulna and with other congenital malformations. The hand may be fixed in extreme flexion or extension, or it may be deviated laterally, thus constituting varieties resembling those observed in club-foot. In the majority of cases, however, the hand is drawn toward the radial side and flexed.

Treatment.—**Passive motion** and persistent efforts to **place the fingers and hand in their normal position**, a **retentive apparatus** or **plaster dressing** being used, are sometimes followed by improvement. **Massage** and **muscle training** are indicated as after-treatment, and may have to be continued for a prolonged period. Tenotomy does not enjoy the confidence of surgeons, as a rule, and is thought by many to be more harmful than beneficial. Sometimes **plastic operations, bone implantations, etc.**, are of marked benefit.

WEBBED FINGERS.—This condition is generally manifested in the union of two or more fingers by skin and fibrous tissue as far as the first phalangeal joints; less frequently, there is union throughout the length of the fingers. The thumb is seldom involved. The deformity is usually due to arrest of development previous to separation of the fingers.

Treatment.—When webbed fingers are congenital, they may be cured by raising a **wedge-shaped flap** from the base of the dorsal aspect of the web and **slitting up** the remainder. The flap is then turned in between the fingers and sutured in the palm, and the raw surfaces on the sides of the fingers approximated as much as possible.

The essential part of all operations for this affection is to get a healthy strip of skin to heal nicely in the base of the web, thus preventing the formation of a cicatricial band at this point.

Case of ulnar defect combined with syndactylism and partial ectrodactylism (congenital absence of fingers). Above the elbow the arm was normal, but the forearm much shortened and

bowed outward. The hand consisted of 2 fingers fused together, but with separate nails, the smaller one on the outer side. The other hand and the feet were normal. H. W. Jones and R. E. Roberts (Jour. of Anat., Jan., 1926).

DE FOREST P. WILLARD,
Philadelphia.

OSSEOUS SYSTEM, DISEASES OF (EXCEPT TUMORS). See BONES, DISEASES OF.

OSSEOUS TUMORS.—Bone tumors may be either malignant or benign. Aside from primary bone malignancy, bones may also become the seat of secondary cancerous or sarcomatous deposits originating from foci elsewhere in the body.

Out of 1144 cases of malignant disease, *bone metastases* were found in 53. The vertebrae were involved in 21.6 per cent.; the ribs, 20.4 per cent.; sternum, 14.7; femur, 14.7; skull, 10.2; humerus, 7.9; pelvis, 4.5; tibia, 2.2; mandible, 1.1; scapula, 1.1, and clavicle, 1.1 per cent. In 34 of the 53 cases, the primary tumor was located in the breast. C. A. Joll (Brit. Jour. of Surg., July, 1923).

Sarcoma constitutes the vast majority of the primary malignant bone tumors, and occurs in various grades of malignancy, from the "benign" giant-cell sarcoma, which has been asserted not to metastasize at all nor involve muscle or fascia, to certain highly cellular sarcomata, which prove extremely malignant and metastasize early to the lungs.

Of 50 cases of giant-cell sarcoma of bones reviewed, 32 were still alive, and 7 were not traced, but 10 had died (including 9 from metastases) and 1 was in a hopeless condition. It seems necessary to modify the opinion strongly held by most pathologists that giant-cell sarcoma is always benign and does not metastasize. The patient's limb was saved in 24 instances. W. B. Coley (Ann. of Surg., Mar. and Apr., 1924).

Ewing classifies as *osteogenic sarcomata* the fibrocellular sarcomata, usually spring-

ing from the periosteum and forming a large growth about the shaft; the telangiectatic sarcomata, or bone aneurisms, which start from bone and vascular structure, contain many vessels, and lead to early spontaneous fracture, and the sclerosing sarcomata. Most of the periosteal sarcomata consist of spindle-cells, though a few show numerous round cells. A thin capsule of bone may form about the tumor, and cyst formation may occur. Long bones are more often the seat of sarcomata than the other bones. Osteogenic sarcomata generally occur before the age of thirty-five, and at times even in children. They often follow trauma. Recurrence nearly always takes place even after early amputation.

In 168 cases of sarcoma of the long bones seen at the Mayo Clinic in patients ranging from 4 to 69 years, a positive history of trauma was noted in 53 per cent. Single severe local injuries were oftener followed by sarcoma than repeated slighter injuries. The commonest symptoms were pain, usually of a mild boring type; local swelling, and tenderness. Joint motion was seldom impaired. The tumors were always fixed, and usually firm, with gradually sloping edges. When in or near a joint, differentiation from tuberculosis is difficult, and X-ray examination may be of aid. In metastasis to the lungs, nodules may be found with the X-rays. H. W. Meyerding (Surg., Gynec. and Obstet., Mar., 1922).

Endothelioma may be single or multiple, spreads over the shaft of the long bones, forming elevated striations, is apt to metastasize, and generally causes death.

Myxoma, according to Bloodgood, is, for practical purposes, a sarcoma with a much greater tendency to recurrence from wound transplantation and a longer interval before death from metastasis.

Multiple myelomata constitute a specific malignant tumor of the bone marrow, with multiple foci of origin, a uniform structure composed of plasma cells or their derivatives, rare metastases, and a fatal termination. The condition may be suspected in cases of backache or bone pains of obscure origin. Suggestive if present is *Bence-Jones*

proteinuria, tested for by layering the urine over concentrated HCl, which yields a white ring (Bradford test), or by heating the urine gently on a water-bath, after slight acidification with acetic acid. If positive, the urine begins to be turbid at 40 or 45° C.; a precipitate forms at 60°, redissolves partly or wholly at the boiling-point, and reappears upon cooling. Multiple myelomata are more common in males, occur between the ages of 40 and 60, and cause death in from a few months to 5 years. The bones affected are most frequently the ribs, sternum, and vertebrae; sometimes also the cranial bones, clavicles, hands and feet, and the ends of the long bones.

Metastases occurred in 1 of the writer's 3 cases of multiple myeloma. Microscopically the tumors are composed of cells irregularly oval in outline and containing an eccentrically placed nucleus. The latter is vesicular and shows a characteristic mural arrangement of the chromatin. The protoplasm is basophilic. Because of the close morphologic resemblance of these cells to plasma cells and because they react negatively to oxidase tests, they are probably not of myeloblastic origin and are not related to the leukemic group, but spring from a series of cells the specific function of which is bone absorption, and may be considered as heteroplastic osteoblasts. The blood changes, consisting of myelocytes, plasma cells, and other abnormal cell types, together with leucocytosis and disturbed percentages of the normal leucocytes, are adequately accounted for by the condition of malignancy and widespread bone-marrow involvement, and have been found in non-myelomatous conditions. The presenting symptom is usually deep-seated pain, constant and distressing, associated with marked weakness and cachexia and occasionally with conditions suggesting organic spinal cord disease. P. F. Morse (Jour. of Cancer Res., v, 345, 1920).

Among the benign growths of bone are exostosis, chondroma, and various kinds of cysts.

Exostosis generally starts after trauma or

inflammation near the ends of long bones, develops in young subjects, and is sometimes pedunculated.

Chondroma grows slowly, is devoid of vessels, and generally shows a fine framework of connective tissue supporting hyaline cartilage. It is not associated with venous engorgement, may be multiple, and in its later stages may degenerate.

Cyst of bone is most frequently a manifestation of osteitis fibrosa cystica (*q.v.*, under BONES, DISEASES OF, Vol. II). Other cysts may be the result of softening of solid growths, such as giant-cell sarcoma, myxoma, chondroma or fibroma, or of bone disturbances such as osteomalacia and osteoporosis. Dermoid cysts and hydatid cysts are also known to occur, and according to Barrie, congenital syphilis, and less often acquired syphilis, not infrequently show cystic or fibrocystic areas in cancellous bone. A relatively common form of bone cyst is the *dentigerous cyst*, or follicular odontoma, due to an excessive number of dental follicles. These cysts, which are usually observed during or soon after the second dentition, consist of a thin, crepitating bony shell containing one or more supernumerary teeth. Bone cysts often appear to follow trauma. The shaft of the affected bone becomes thinned and expanded; at times a pathological fracture is the first evidence of the condition to be noticed. Consolidation is not precluded by the presence of the cyst.

DIAGNOSIS.—Persistent, severe, localized pain in a long bone, according to Coley, should lead to suspicion of a malignant growth. Early sarcoma differs from tuberculosis in rarely involving joints. Exostoses are slower in growth, painless, harder, and more uniform. In true sarcoma, regardless of the degree of malignancy, there is never a resting stage, the increase in size of the neoplasm being progressive and constant (Barrie).

Most bone tumors can be correctly diagnosed by the X-ray, but care in interpretation is necessary. In periosteal sarcoma there is a tendency to form spicules at right angles to the shaft, whereas in myositis ossificans there is usually a sharply defined periosteal line; in case of doubt, repeated measurements at 2-week intervals are of great value (Coley). Myelomata show a

globular expansion without a shell of new bone on the outside and without tendency to involvement of the shaft. According to Sosman and Canter, the commonest errors in X-ray interpretation are the reporting of syphilitic periostitis as periosteal sarcoma and of a central destructive lesion as osteomyelitis.

X-ray study is sometimes more useful than histologic examination in differentiating bone malignancy from an ordinary mild inflammation. In sarcoma the X-ray impression is less one of multiple foci than in osteomyelitis, which usually exhibits light areas in the bone. Yet sarcoma does occasionally give an atypical picture as of multiple foci, to which was added in 3 of the author's cases hyperostosis simulating syphilis. Syphilis is excluded if there are small, irregular erosions of the anterior margin of the bone. It is possible for sarcoma to involve the whole femur without greatly increasing the thickness of the bone. L. Tavernier (Arch. franco-belges de chir., June, 1923).

Diagnostically useful *blood changes* in metastatic bone tumors described. These changes are due to irritation of the marrow by the secondary deposits, and are classed as either pseudopernicious or pseudoleukemic. To distinguish the former type from actual pernicious anemia the occasional presence of a low color index is of value. To distinguish the pseudoleukemic type from leukemia, a valuable feature is the invariable absence of a marked increase of basophile leucocytes in metastatic anemia, whereas such an increase is almost constant in leukemia. The presence of even a few basophile myelocytes is strong evidence of actual leukemia. A. Piney (Brit. Jour. of Surg., Apr., 1924).

Opinions differ somewhat as to the advisability of excising tumor tissue for diagnosis. Bloodgood favors the procedure, but promptly applies 50 per cent. zinc chloride solution to the cut tissues. Some approve of exploration only where arrangements have been made for an immediate radical operation, should it prove indicated. According to Coley, exploratory incision is

permissible in doubtful selected cases, but not as a routine measure. A. P. C. Ashurst argues that tumors thought benign should not be left unexplored, because recovery will seldom take place without surgical evacuation, and if the tumor is of intermediate type, prompt operation may prevent its becoming malignant.

The clinical behavior of the tumor is a most valuable diagnostic indication; in many cases the only true test is that of time. J. J. Morton and W. C. Duffy (Arch. of Surg., Nov., 1923).

A correct diagnosis of bone tumor can be made only by combined consideration of the evidence from the history, clinical and X-ray examinations by consultation with the roentgenologist and pathologist. Often a pathologic examination of the growth itself is also necessary. The writer dissents, with Coley, Bloodgood and Codman, from Ewing's view that the therapeutic test by radiation should be applied first. Both for diagnosis and treatment he advocates *en bloc* removal of the tumor-bearing bone in suitable cases. J. M. Hitzrot (N. Y. State Jour. of Med., Aug., 1924).

TREATMENT.—In benign bone tumors, conservative surgery, as exemplified by **resection**, is indicated. Benign cysts may be treated by **curetting**, followed by **packing**, **swabbing with tincture of iodine**, or **filling with Mosetig-Moorhof bone-wax**. Solitary cavities larger than a pigeon's egg may be **filled with bone shavings** from adjacent bone, to hasten repair (Barrie). **Resection** followed by **bone-grafting** may sometimes be carried out where there are several cysts.

Bone cysts are not of traumatic origin. The trauma merely calls attention to their presence. Indeed, the X-ray shows that trauma exerts a curative action, causing the fluid to escape, after which the periosteum begins to repair the bone. **Immobilization** is all that is necessary when the cyst has been ruptured, and likewise often where it is unruptured but the bone is one of minor importance, such as the fibula. In the case of the femur or tibia, however, the cyst should be **trephined** and **scraped** out, without

attempting to fill the cavity or drain it. **Resection** should never be done without histologic examination, as conservative treatment should be the rule for benign cysts, usually situated in the humerus or near the knee. Mouchet and Le Gac (*Arch. franco-belges de chir.*, Jan., 1922).

In a case of large myelogenous sarcoma of the tibia in a girl of 8 years, the writer performed **resection** and inserted a piece of tibia from the opposite limb to make good the defect. Three months later, upon removal of the plaster cast, union at both ends of the transplant was found to have occurred, and complete functional use of the limb was later recovered. Riosalido (*Arch. españ. de ped.*, July, 1923).

Autoplastic bone grafting is frequently successful in osteosarcoma of the radius, whereas grafts from other individuals seldom succeed. Mauclair (*Bull. de l'Acad. de méd.*, Nov. 25, 1924).

In sarcoma, duly identified through careful differential diagnosis, **amputation**, whenever possible, and closure without drainage constitute the most dependable procedure. After operation, or where operation is refused, the **X-rays** and **radium** are available agents, and **Coley's toxins** should always be tried in sarcoma. Murphy sponsored the local operation of **excision**, followed by **bone grafting**, in sarcomata that are encapsulated and not of the most malignant character. This proceeding has the advantage of being likely to secure the patient's consent to operation much earlier than in the case of amputation, with correspondingly lessened chances of metastasis. In giant-cell tumors the prognosis upon excision is favorable; **amputation** may, however, be required if a large joint has been invaded. No lasting effective treatment for multiple myelomata is known; **radium** and the **X-ray** may be tried.

In bone sarcoma, the writer finds the X-ray pictures quite characteristic. If diagnostic incision is decided upon, great care should be taken to obtain a typical portion of the tumor. Giant-cell sarcomas do well following **curettage**, but the procedure may transform

a benign process into one clinically malignant. **X-ray** and **radium** therapy avoids this danger. Myelomas offer a poor prognosis because of their multiplicity, but each individual growth is very susceptible to radium and the X-rays. Angio-epitheliomas have a very poor prognosis, but diffuse endotheliomas respond quickly to radiation. Of the osteogenic sarcomas, all the cellular and vascular tumors when treated surgically seem to have been fatal within a few months. The encapsulated fibrosarcomas, however, are at first capable only of local recurrence. J. Ewing (*Arch. of Surg.*, May, 1922).

Recovery from a giant-cell sarcoma at the right iliac crest, which softened the entire ilium, under **deep X-ray** therapy. A series of 5 daily exposures, each of 25 minutes, was first given over the anterior aspect of the growth, and immediately after a similar series over the posterior aspect. The dosage was 2 skin units, with a current of 1.5 ma., 2 mm. aluminum filtration, and a focal distance of 24 cm. Ten days later, further treatment was given, and 10 skin units added for enlarged glands in the vicinity—a procedure repeated two months later. Under this treatment the tumor in four months was transformed into a benign osteoma. Marked general improvement occurred, and the recovery was still maintained 10 months later. H. Wachtel (*Jour. de radiol. et d'électr.*, Dec., 1924).

In myxoma, **amputation** or **resection** without exploratory incision have alone yielded permanent cures so far, though in 1 case the patient was still well 9 months after **cauterization** with soldering irons upon discovery of the growth at exploratory incision. Bloodgood (*Ann. of Surg.*, Dec., 1924).

Malignant bone tumors call for **amputation**. The criterion for the malignancy is not local recurrence—which may occur with a benign tumor—but metastasis at a distance, reproducing the structure of the primary tumor. If amputation is refused, the radiologist should be called in. Huet (*Jour. de chir.*, Jan., 1926). S.

OTITIS MEDIA. See MIDDLE EAR, DISEASES OF.

OUABAIN. See STROPHANTHUS.

OVARIAN EXTRACT. See ANIMAL EXTRACTS.

OVARIES AND FALLOPIAN TUBES, DISEASES OF.—MALFORMATIONS OF THE OVARIES AND TUBES.—Malformations of the ovary and tube may be congenital or acquired. Both ovaries may be congenitally absent. Absence of the ovaries is generally associated with defective development of the uterus. An individual so affected does not undergo the physical changes incident to puberty, and subsequently more resembles the male. Where one ovary is absent, the corresponding half of the uterus and tube are likely to be deficient in development. The corresponding kidney has also been found absent. A third or accessory ovary is of infrequent occurrence. Constricted portions of the ovary have been mistaken for supernumerary ovaries. Small islands of ovarian tissue have been found upon the peritoneum. Such an anomaly or an incomplete removal of an ovary are undoubtedly the cause of menstruation following oöphorectomy. With absent or partially developed ovaries the sexual functions are never performed normally. The absence of one ovary or its destruction by disease produces no effect upon either sexual desire or conception. It is very important to determine the absence of the ovaries or existence of rudimentary organs, as, when such conditions are recognized, the futility of measures to establish menstruation is demonstrated.

Defective development of the tubes

consists generally in faulty development of the fimbriæ at their abdominal ends. One tube may be unusually short or well developed and the other rudimentary. The most frequent alteration is the occurrence of supernumerary ostia, or tubal openings. These may appear as mere apertures or be surrounded by fimbriæ. Defective development may cause the tube to be unusually convoluted. The convolutions may be so marked as to form strictures which contract the cavity sufficiently to render the woman sterile. In failure of the ovary to descend, the tube may be drawn out at the higher level. In some recorded cases the attachment of the tube has been well below the usual fundal insertion. Congenital sacculations or diverticula in the endosalpinx may play an etiological rôle in tubal pregnancy.

CONGESTION OF THE OVARY.—Ovarian hyperemia occurs physiologically during ovulation and coition. It is not infrequent at the establishment of the menstrual function, especially in those individuals in whom the mental faculties have been developed at the expense of the physical structure.

Marked congestion may result in extravasation of blood into the follicles and stroma of the ovary, more frequently into the former. Such hemorrhages may lead to the follicles being distended to the size of a hen's egg or even that of an orange. This is later converted into a pigment having the consistence of honey, with a chocolate color. Such conditions have also been associated with heart disease, typhoid fever, phosphorus poisoning, and in excessive burns. Follicular apoplexy, as well as ovarian

congestion, mostly occurs in the sexually immature. Such a collection may be absorbed, or the distention becomes so great as to cause rupture of the ovary and a large hemorrhage into the peritoneal cavity. Occasionally a fatal peritonitis may follow.

Sampson in 1922 demonstrated, however, that most ovarian hematomas result from invasion of the organ by Mullerian elements derived from the ends of the Fallopian tubes or the endometrium. Such implants are thought to take part at times in menstruation and introduce blood in the ovarian substance.

A tube may become congested through torsion of the pedicle of a cyst. Moderate congestion simply causes distention of the tube; more marked obstruction of its circulation will result in rupture of small vessels and extravasation of blood into the tube and surrounding parts. If still more marked, it may cause necrosis of both tube and the tumor.

Symptoms.—Congestion of an ovary and tube is attended with pain in the corresponding side of the pelvis and will often precede the menstrual flow by a week or ten days. With the establishment of the bloody flow the engorgement is relieved, the pain ceases, and many patients experience greater comfort during the menstrual period. The flow is generally prolonged and excessive, not infrequently amounting to hemorrhage. The patient is weak, pale, and anemic.

Diagnosis.—Such hyperemia should be suspected as the cause of excessive and prolonged menstrual flow near puberty when the appearance of the patient is characterized by anemia and she complains of weakness, pain, and tenderness within the pelvis,

more marked upon the left side, not infrequently associated with pain in the corresponding mammary gland.

Follicular apoplexy presents no distinctive symptoms, and is rarely recognized.

Treatment.—The progress of the patient will depend upon the **hygienic management**. She should be taken away from school, denied the study of music and the reading of emotional literature. City girls should be sent to the **country** or **seashore**. The action of the **bowels** should be **carefully supervised** and a **generous diet** given, from which **pastries and sweets** must be largely **excluded**. A **morning sponge-bath followed by friction** with a coarse towel is advisable. **During** and a few days **preceding the menstrual period** the patient should be **confined to bed**. If the flow is generally excessive the period should be preceded for a few days by the use of **fluidextract of ergot**, f5ss (2 c.c.), **ergotin**, gr. ij (0.13 Gm.) in capsule, a tablet triturate of **hydrastinine**, gr. $\frac{1}{8}$ to $\frac{1}{4}$ (0.008 to 0.016 Gm.), three times a day, or **cotarnine hydrochloride**, gr. j to iss (0.06 to 0.1 Gm.) every three hours. During the menstrual intervals **potassium bromide**, gr. x (0.6 Gm.), should be administered three times daily, or it might be combined with **potassium iodide**, gr. ij to iij (0.13 to 0.2 Gm.), well diluted. Tonics—such as **quinine**, **strychnine**, or the **bitter tinctures**—are serviceable. The anemia may tempt one to use iron, but this remedy is better postponed until hemorrhagic symptoms are under control.

DISPLACEMENTS OF THE OVARY AND TUBE.—**HERNIA OF THE OVARY.**—Hernia through the inguinal canal is a rare condition.

It is generally found upon the left side. Crural hernia is more frequent, and the ovary has also made its exit through the greater sacro-sciatic foramen and the umbilicus. Chenieux reported an ovarian cyst in the right buttock. Most probably the first surgical removal of the ovaries was performed by Pott for ovarian hernia. Hernia of the ovary is generally secondary, and results from adhesions to the omentum or the intestine. The displaced organs may readily be mistaken for glands or labial tumors. The constant presence of such a tumor; the dull, sickening pain; extreme nausea, and great tenderness should make the diagnosis comparatively easy.

Treatment.—**Taxis** may be judiciously and carefully attempted. An **ice- or sand- bag** is to be applied, and, when the reduction can be accomplished, a **truss** should be worn. When the hernia is irreducible, the **sac** should be **opened** and the **ovary replaced or removed**.

PROLAPSE OF OVARY.—Prolapse of an ovary and tube is generally dependent upon the position of the uterus. The uterus retroflexed or retroverted, the ovary is no longer supported upon the broad ligament, but hangs from it, and generally lies in Douglas's *cul-de-sac* beneath the uterus. The ovary may be displaced while the uterus retains its normal situation. This displacement more frequently involves the left ovary. Displacement is characterized by tenderness and pain during coition and defecation. Pain during the former may be so great as to preclude its performance. The condition is recognized by vaginal and rectal palpation, in which a movable mass is found

that can be pushed upward or whose pedicle can be recognized. The tumor is exceedingly sensitive, and the pressure upon it causes a sickening sensation.

The displacement of the ovary develops chronic inflammation, and acute infections may fix the tubes and ovaries behind the uterus.

Treatment consists of **rest, regulation of the bowels, prohibition of the marital relation**, and persistent efforts on the part of the patient in the **genu-pectoral position** to raise the heavy organs from the pelvis. The organs raised may be maintained in place by a suitable **pessary**. Pessaries with heavy posterior bar are more satisfactory, as they fill up the posterior *cul-de-sac* and afford less opportunity for the downward displacement of the ovary and tube. After various pessaries have been unsuccessfully tried, and the patient is still incapacitated for her duties, an **abdominal section** should be performed and **fixation** effected by restoration of the infundibulopelvic ligaments; suturing the ovarian pedicle to the anterior parietes at a point corresponding to the exit of the round ligaments; or puncturing the broad ligament beneath the tube, pushing the ovary through, and suturing the opening; the ovary then rests upon the ligament. Descent of an ovary alone does not justify extirpation.

Bonney advocated an operation that consists in **pleating the ovarian ligament** by means of a "gathering" stitch which, beginning on the posterior aspect of the uterus, just within the point of origin of the ligament, terminates at its attachment to the ovary. The ligament by this means is not only shortened but thickened, and the ovary is brought up under the uterine cornu.—Ed.

Prolapse of the ovary and tube is very common where these organs have become considerably enlarged, so that it is not unusual to find tubal and ovarian enlargements behind the uterus.

INFLAMMATIONS OF THE OVARY (OÖPHORITIS).—Inflammation of the ovary is known as oöphoritis, and perioöphoritis when the surrounding peritoneum is involved. It may be either acute or chronic. We find distinctions of parenchymatous, follicular, and interstitial inflammation, but such conditions are not recognized clinically.

ACUTE OÖPHORITIS.—**Symptoms.**—There are no characteristic symptoms of this condition. In all varieties of pelvic inflammation pain is the only persistent symptom. In oöphoritis it may be intense and lancinating, especially in the left inguinal region, with marked tenderness, elevated temperature, rapid pulse and frequent chills. The entire pelvic region may, however, be the seat of pain, or, if localized, the situation of the pain bears no consistent relation to the organ involved. The symptoms in oöphoritis are intimately associated with those of tubal disease.

In perioöphoritis pain may be more or less distinctly localized at the pelvic brim and extend down the thigh. At times pain is felt in the breast on the same side. Apart from this, the symptoms are similar to those of a mild peritonitis.

Acute inflammation may terminate in resolution or in the development of an abscess, its rupture, and the occurrence of rapidly fatal peritonitis; or the disease may become chronic. Most frequently it is associated with disease of the tube.

Etiology.—Acute oöphoritis is most commonly the result of infection beginning in the vagina or uterus and reaching the ovary by extension along the mucous membrane of the tube or by way of the lymphatics or blood-vessels. The infection may be of the septic type, following parturition, abortion or trauma, in which event ovarian abscess is likely to result; or, may be gonococcal, with a tendency to perioöphoritis and fixation of the ovary. Among other conditions with which the disorder has been connected are mumps, the exanthemata, influenza, acute rheumatism, long-continued endometritis, and poisoning by arsenic or phosphorus.

Pathology.—The ovary rapidly attains to three or four times its normal size, is filled with serous fluid, and in the more severe grades with pus. It has attained the size of a man's head, but is generally of the size of a hen's egg. When inflammation results in the formation of an abscess, its watery contents may be absorbed and leave a cheesy mass. In the milder forms of inflammation resolution occurs.

An acute inflammation may be followed by cirrhosis of the ovary from contraction of the increased connective tissue. Such an ovary may be reduced to the size of a hazel-nut. This form of inflammation involves both ovaries, while abscess usually occurs in but one.

In perioöphoritis the capsule of the ovary becomes thickened and the entire organ fixed by perimetric bands of adhesion. Thickening of the capsule renders it less likely to rupture when a follicle matures, and a cyst follows. A large number of such follicles form a *cystic ovary*. The parti-

tions between these break down and cysts of considerable size are formed.

Treatment.—This consists chiefly, in the early stages, of absolute **rest in bed** in the **Fowler position**; an **ice-bag** over the seat of pain; **continuous proctoclysis**; sedatives, such as **bromides**, for the relief of pain, or **morphine** if required. The bowels should be kept open with **enemas**, but purgation is inadvisable. Further measures indicated are identical with those for inflammation of the tubes (*q.v.*).

CHRONIC OÖPHORITIS.—

Symptoms.—The pain may be located in the region of the ovary, and radiate to the back, thighs, umbilicus and breasts. It is persistent, increased by locomotion, missteps, or jolting, and becomes exaggerated as the menstrual period approaches. With free menstrual flow the pain is relieved or disappears. When slight, it increases. Symptoms of spinal irritation are frequently present during the menstrual periods. Marked nervousness is generally complained of; this may assume a neurasthenic or hysteric type. Sterility is a constant result. The ovaries, while tender to pressure, are not much enlarged. When they are prolapsed, the symptoms are aggravated.

Physical examination must be conducted with care. When an enlarged ovary is prolapsed and fixed by inflammatory exudate, a careless observer may mistake it for retroflexion of the uterus.

Diagnosis is determined by finding large sensitive ovaries, increased distress for a week or ten days prior to menstruation, mammary pain, and painful defecation and coition. Rectal examination will be found of service. The ovary may, however,

become fixed in the pelvis by an extensive infiltrate, rendering it immovable and its situation difficult to discover. As a matter of fact, in the majority of instances the definite existence of oöphoritis becomes known only at operation.

Etiology.—Chronic inflammation is a sequel of the acute and due to the same causes. It has been ascribed also to long-continued congestion from excessive sexual intercourse or other causes. Hematogenous infection from diseased tonsils is deemed a possibility. Colon bacillus infection may reach the ovary through adhesion to the bowel, and tuberculous infection, from tuberculosis of the peritoneum or Fallopian tubes.

Treatment.—**Relief from any source of irritation, interdiction of vigorous exercise and prolonged standing, and interruption of marital relations** are among the palliative measures available pending investigation and definite removal of the cause. The patient should **rest in bed during menstruation**. **Potassium bromide** or **iodide** may be given, if desired, and local **counterirritation with iodine** or small **blisters** availed of. Other medical measures, as well as the surgical procedures frequently necessary if a cure is to be obtained, are the same as those indicated in inflammation of the tubes (*q.v.*).

INFLAMMATION OF THE TUBES.—**Symptoms.**—Tubal disease presents no characteristic symptoms. Patients complain of pain, tenderness, and more or less induration of the pelvis as a result of the inflammation in the peritoneum. The uterus, ovaries, and tubes are fixed, not infrequently in a mass which cannot be differentiated, so that one is unable

definitely to determine the position and relation of the uterus to the inflammatory collection. The progress of the inflammatory condition, the interference with the nutrition and action of the intestinal canal, and also the absorption of septic matter, bring about an impaired state of the general health.

In acute salpingitis the onset may be insidious or abrupt. Constitutional reaction varies in degree, but is usually present. Pain may be moderate or severe, localized or diffuse, and is aggravated by motion or manipulation. Leucorrhea coexists, while menstruation is usually profuse, prolonged and painful. Almost always one or both thighs are flexed on the abdomen, which is rigid, tender and more or less distended.

Diagnosis.—The history of the patient and course of the disease would indicate the existence of pelvic lesions. On vaginal examination the least manipulation of the cervix will cause great distress in the acute cases. Bimanual examination reveals more or less fixation of the uterus, a mass situated upon one or both sides or in Douglas's pouch, the contents of the pelvis agglutinated, with a history of pain and tenderness. A recognition of points of softening should permit of arriving at a diagnosis of pelvic suppuration. A blood count will indicate the virulence of the infection by the leucocytosis.

In the less severe inflammation resulting in an hydrosalpinx, one finds upon one or both sides of the pelvis a retort-shaped mass, with its smallest portion directed toward the uterus and the larger extending outward into Douglas's pouch. The mass is movable and differs from an ovarian cyst

in having a retort- or pear-shape. Fluctuation may be indistinct, according to the size and tension of the mass.

Etiology.—Tubal disease is most frequently a result of infection, which may follow an abortion or labor, careless examination, or operation upon the cervix or uterine cavity. A more frequent cause is gonorrhea, which travels through the uterus to the tubes and pelvic peritoneum. Another cause is the tubercle bacillus. This latter infection occurs more frequently in the tube than in any other portion of the genital structure. Less frequently tubal disease arises as a result of syphilis and actinomycosis.

The most frequent cause of hematosalpinx is ruptured ectopic gestation with retention of blood in the tube. The blood subsequently becomes thinned and mixed with mucus.

A collection in a tube adherent to an ovary, which possibly contains a number of cysts, is likely, upon increase in size of the two collections, to have the intervening wall or septum become so thinned as to break down, the two structures becoming one, and forming a *tubo-ovarian cyst* or *tubo-ovarian abscess*, according to the character of its contents. As the sac enlarges, its mucous membrane becomes smooth and the wall gradually thinned until it forms a tumor of considerable size. It may drop into the pelvis, fill up Douglas's pouch, and rupture, its contents, unless sterile, infecting the peritoneum and causing a localized peritonitis and the formation of a large purulent or serous collection in the *cul-de-sac*.

Pathology.—Tubal inflammation may be acute or chronic. Chronic inflammation results in salpingitis, peri-

salpingitis, accumulation of fluid in the tube forming an hydrosalpinx, pyosalpinx, or hematosalpinx, according to the activity of the inflammation and infectious character of the germs. Inflammation consists in, first, thickening of the mucous membrane, frequently desquamation of its epithelium, and enlargement of the tube. The longitudinal folds of mucous membrane, becoming abraded and lying in apposition, infrequently become adherent, forming what appear to be cysts. At other points, particularly in the isthmus of the tube, thickening of the membrane occurs, forming pea- to bean- sized nodules, which are spherical in form, with sharp margins, and give the impression of tumor formations. They are firm in consistence, thick, vascular structures, sometimes also double sided, and symmetrical. This inflammation has been denominated *salpingitis nodosa isthmica*. With the extension of the inflammation to the mucous membrane, increased secretion follows, portions of which are discharged into the peritoneal cavity, producing an inflammatory condition, which causes the plastic material to be thrown out and close up the end of the tube. With inflammation and thickening of the mucous membrane, it becomes contracted and leads to retraction of the fimbriæ; or, by the contraction of the muscular layer it pushes the peritoneum over the abdominal orifice which, becoming agglutinated, closes the opening. Occasionally one or more fimbriæ may protrude, thus leaving a track by which fluid subsequently may escape into the peritoneal cavity. With the closure of the tube the increase of contents causes an obtuse-

ended tumor, which gradually fills with fluid, forming occasionally a pear-shaped mass, or, where its walls are in places constricted by an increased amount of fibrous tissue, a sausage-shaped tumor is formed. This sac, when its contents are serous, is an *hydrosalpinx*, and occasionally becomes greatly distended, forming a sac as large as a child's head, which increases in size toward the abdominal end, and presents a thin-walled tumor which is more or less free, and about which adhesions may be entirely absent. In a more acute infection the contents become purulent (*pyosalpinx*), and we have an inflammation extending through the wall of the tumor, involving its peritoneal surface, and not infrequently causing extensive peritoneal inflammation by which everything in the pelvis is matted together. Such a sac may subsequently rupture, spread out the broad ligament, and form a pelvic abscess of considerable dimensions.

When the adhesions between the intestine or bladder and sac are firm, rupture may occur either into the intestine or bladder and decrease the tumor by the discharge of the pus; or the wall may become so thinned as to permit its discharge through the abdominal walls, into the vagina, or more seriously into the peritoneal cavity, when it may be followed by rapidly fatal septic peritonitis. When the sac empties into the bladder or intestine, it does so at a level which does not permit drainage of the entire sac and consequently it is only the overflow that escapes. The patient is subjected to a long-continued drain, which results in increased anemia and debility.

Prognosis.—Acute salpingitis is very rarely fatal, except in severe puerperal forms. Intraperitoneal rupture, with generalized peritonitis, is extremely uncommon. Cure with restoration of function of the tubes is, however, scarcely to be hoped for, although there is a slight possibility of such restoration. Conception after salpingitis is very unlikely. Ectopic pregnancy is favored by the condition if conception does take place.

In cases complicated by pelvic cellulitis the prospects of permanent recovery are good if drainage is instituted early. Where pelvic peritonitis occurs, however, the prognosis is not so favorable, the patient being exposed, apart from the possibility of a fatal issue, to recurrent attacks of peritonitis and, in some instances, a life of chronic invalidism.

Study of 200 cases of tuberculous salpingitis. It was found in nearly 1 per cent. of all women admitted to the gynecological service of the Johns Hopkins Hospital, and $1\frac{1}{2}$ times as frequently among colored women as among white. Out of every 13 abnormal tubes removed at operation, 1 was tuberculous. Sixty per cent. of the married patients were sterile. A family history of tuberculosis was reported in 22.5 per cent., while in an additional 2.5 per cent. the consort had active pulmonary tuberculosis. The chief complaint was pain (74.5 per cent.), usually in the lower abdomen (82.5 per cent.); there was leucorrhea in 72 per cent.; nearly $\frac{1}{2}$ had dysuria, nycturia, or pollakuria; more than $\frac{1}{2}$ were constipated; $\frac{1}{2}$ had lost weight. About $\frac{1}{4}$ had pulmonary tuberculosis. The prognosis is grave in the presence of tuberculosis elsewhere in the body, when there is fever, and when the peritoneum is involved. The operative mortality was 7.6 per cent.

Follow-up letters, etc., showed that

of 90 patients, 78 were living from 2 months to 30 years after the operation. Nearly all those alive were in good condition. J. P. Greenberg (Bull. Johns Hopkins Hosp., xxxii, 52, 1921).

Treatment.—If the attack is acute efforts should be directed to bringing about a subsidence of the acute symptoms. Symptomatic recovery is generally procurable with medical measures. The patient should be confined to **bed**, in the **Fowler position**. One or two **ice-bags** should be applied to the lower abdomen, properly covered, for a period not exceeding three or four days, whereupon, the acute symptoms subsiding, and the temperature becoming normal and the pain and tenderness lessened, **hot water bags** or **hot compresses** should be substituted. Fomentations covered with oiled paper, muslin or silk may be used, the heat being maintained by a **hot water bottle** or **electric pad**.

Hot vaginal douches of, *e.g.*, 1:4000 **mercury bichloride** solution or 30 minims (2 c.c.) of **Lugol's solution** to the pint (500 c.c.) of water, should be given two or three times a day, especially in early gonococcic cases. Between these irrigations the vulva may be kept covered with a pad moistened with 3 per cent. **phenol** or 20 per cent. **alcohol** solution. More effective than the hot vaginal douches, however, are **rectal enemas** of a pint to a quart (500 to 1000 c.c.) of **hot water**, to be retained as long as possible.

Other medical measures consist in the relief of pain by **analgesics**, the institution of **continuous proctoclysis**, and maintenance of bowel action with low, warm **soapsuds** and **water enemas**. Catharsis is inadvisable,

favoring extension of inflammation. On the other hand, **opium** may be given, particularly if there be much peritoneal involvement, to delay extension by reducing peristalsis.

In puerperal cases more especially, encouraging results have followed **infusion of immunized blood** or small doses of **citrated blood** every three days.

After the more acute symptoms have subsided, resolution and absorption may be promoted by **pressure** in the form of bags of shot (3 to 5 pounds) or through the practice of **pelvic massage**. Further promotion of absorption may result from small **blisters** or painting with **tincture of iodine**.

In chronic salpingitis the following measures have been found useful by Palmer Findley: **Vaginal douches** of water at 110° F. (43.3° C.), of 20 minutes' duration, given with the patient recumbent, and repeated twice daily. **Glycerin and ichthyol tampons** (93:7 parts) are also used daily. The combination of these measures is said to afford the most effective means of depleting the congested pelvic tissues.—Ed.

Autogenous vaccine recommended as an addition to the usual measures in adnexitis. It will at least relieve the pain, and often the lesions retrogress more rapidly. In 40 out of 50 cases the results were convincing after 1 or 2 series of 10 injections each. The treatment is guided by the local and general reactions. It is contraindicated by tuberculosis and albuminuria. Chevrier, Fumery and Dausse (Rev. franç. de gyn. et d'obst., Apr. 10, 1924).

Intravenous calcium injections in severe acute adnexal inflammations recommended. Pain and fever generally subside after 5 or 6 injections. The dose was 10 c.c. (2½ drams) of a 10 per cent. solution of **calcium chloride**, injected on alternate days to a total of 6 to 8 injections. No effect

on the inflammatory leukocytosis was observed. Fekete (Mon. f. Geb. u. Gyn., Sept., 1924).

There is an important field for protein therapy by **milk injections**—usually 5 to 10 c.c. every 3 to 5 days—in pelvic infections, particularly if gonorrheal. The tubes, uterus and probably the bladder are favorably influenced, while the ovaries seem refractory. Exudates are brought to absorption, or a circumscribed suppuration is hastened so that surgical attack is rendered possible. Gellhorn (Amer. Jour. of Obstet. and Gyn., Nov., 1924).

To promote absorption in chronic salpingo-oöphoritis, **glycerin** and **ichthyol** are of value. The former may be applied to the vaginal roof on tampons of absorbent wool at night, while ichthyol is best used in vaginal suppositories, *e.g.*, ichthyol, 12 grains (0.8 Gm.), in cacao butter, 2 drams (8 Gm.). A **hot plain water douche** at 112 to 115° F. (44.4 to 46.8° C.) should first be given slowly to induce hyperemia, and then the suppository passed up to the vaginal roof and left all night, to be washed away in the morning. Alternate nights for a fortnight is sufficient for this treatment. If 2 such courses at a week's interval fail, palliative treatment may generally be regarded as useless. T. G. Stevens (Lancet, Jan. 30, 1926).

If there is evidence of pelvic involvement, **saline enteroclysis** should be kept up both day and night. Locally, **hot applications** should be made, and a **hot vaginal douche** consisting of 2 or 3 gallons of solution should be administered three times a day. Operative intervention is indicated if these measures, along with others already mentioned for salpingitis, fail to arrest the febrile disturbance and pelvic inflammation. The pus in the pelvic cavity should be evacuated, if possible, by vaginal incision and drainage.

The writer recommends, in acute inflammation of the uterine adnexa,

hot moist applications, with or without the following liniment:—

R *Extracti opii*,
Extracti belladonnae,
 āā 3j (4 Gm.).
Extracti hyoscyami . 3ss (15 Gm.).
Chloroformi f3iiss (10 c.c.).
Olei olivæ 3iiss (75 c.c.).

Injections of hot water constitute a useful measure. The receptacle should hold 2 liters (quarts) of water and must not be over eighteen inches above the level of the bed. A. Robia (Nouveaux remèdes, June 8, 1913).

Referring to 25 women with genital tuberculosis, for which he had operated from 15 months to over 4 years before, the writer states that 2 had since died; 5 presented unsatisfactory objective signs, though feeling well, while 18 were practically cured, their earning capacity being restored. Differential diagnosis is deemed immaterial, as the clinical picture of chronic disease in the uterine adnexa always calls for a **laparotomy**. If adhesions contraindicate excision of the focus, intervention must be limited to **local medication** of the abdominal cavity. One should wait until the temperature is normal before operating. Kröner (Arch. f. Gynak., cv, Nu. 2, 1916).

The writer recommends **dehydrated magnesium sulphate**, i.e., the sulphate relieved of water of crystallization by heat, to relieve the pain in acute salpingitis. One-half ounce of the salt is placed against the posterior wall of the vagina and held in position by a tampon of absorbent cotton. This procedure is repeated every 24 hours for a period of time varying from 6 to 12 days. Rest, a light diet and a saline laxative are given. Butt (Jour. Ark. Med. Soc, xiv, 105, 1917).

While all are agreed that the retention of an infected uterus, after removal of infected tubes, is a menace to the woman's future health, the writer believes that the care taken to preserve ovulation should also apply to that of menstruation, as ovulation without menstruation contributes

little to the patient's well-being. The greatest pathology in the uterus is to be found in the cervical glands and in the fundal region and pars interstitialis of the tube. To clear the patient from these infective foci, many operators perform a panhysterectomy, but this arrests the menstrual flow. The writer treats the cervix by linear cauterization or excision, following which he attacks the tubes and fundus of the uterus by the method of Beutner and Bell, which consists of the ablation of both tubes with resection of the infected fundus of the uterus, leaving sufficient healthy uterine body to conserve the menstrual function and one or both ovaries to continue ovulation. The operation should be done without interfering with the ovarian circulation, hemostasis being secured by the ligation of the individual branches supplying the tube and fundus. Polak (Jour. Amer. Med. Assoc., lxix, 1938, 1917).

Extra care must be exercised in the treatment of cases in which pus has occurred that the infective processes are not extended. **Rest** is imperative; manipulation must be carefully avoided. The **intestinal canal** should be **kept open** to promote by it the drainage of the pelvis. Judicious **nutrition** should be maintained, but stimulation avoided. Where large inflammatory collections, whether serous or purulent, are present no hope for permanent relief can be expected until the **collection** is **evacuated or removed**. The method of treatment, however, will depend somewhat upon its situation and size.

A large collection filling up Douglas's pouch, or distinctly recognized through the vagina, is preferably attacked by **vaginal incision**, in order to remove the large quantity of infectious material without disturbing the barriers nature has erected

for the protection of the peritoneal cavity. Collections of pus may be evacuated by free **vaginal incision through the posterior vaginal fornix**; the incision is made through the prominent section of the accumulation, follows a semicircular course, and is generally made long enough to admit two fingers. With the cervix drawn down by vulsellum forceps, blunt-pointed scissors, curved on the flat, may be conveniently used for incising. The finger is next introduced into Douglas's pouch, and being shifted to the right or left, usually finds the septic mass without difficulty, especially with the aid of the right hand over the abdomen, as in ordinary bimanual examination. The mass having been punctured with the finger and the **contents evacuated**, an examination is made to detect any further collections, and followed by introduction of a **drain** of rubber tubing, iodoform gauze, or both.

Sometimes this procedure will result in subsidence of the purulent process and cure of the patient. Such an attempt should always precede an **abdominal section** whenever there is present a large collection of pus that can be reached *per vaginam*. The only objection to the plan of treatment is that it is not always curative.

The most effective procedure in Fallopian tube infection is to open the abdomen, **break up the adhesions**, and **remove the infected tube and ovary**. The exposure of the field can be greatly enhanced by placing the patient in the Trendelenburg posture, by which the sight as well as touch may be exercised in the enucleation and removal of the mass, but the danger of spreading infection to the healthy surfaces is increased; conse-

quently, it is better to wall back the intestines with gauze packing through a free incision and complete the procedure with the patient on a level table.

While **extirpation of a tubal sac** is the proper treatment in large collections, whether of blood, pus, or serum, abdominal section should not be considered as required in every case of tubal inflammation. In the slighter forms of disease, and in the early stages, the **hygienic measures** already indicated, supplemented by palliative **curettement** and **uterine drainage**, will often be sufficient to establish resolution in the slighter forms. The maintenance of uterine drainage will frequently be sufficient to establish a cure, both clinically and functionally. In other words, patients who have had extensive tubal inflammation of gonorrheal origin have recovered and subsequently given birth to children. At times the uterine end of the tube remains patulous, permitting, in certain positions of the body or in overaccumulation, the evacuation of the sac through the uterus when it is no longer palpable until it again refills. This condition is known as *hydrops tubæ profluens*.

The extension of inflammation from the uterus to the tubes and the changes in that organ resulting from inflammation prior to the removal of the tubes, which not infrequently continue nervous and other manifestations, led Péan and his followers to advocate the removal of the uterus *per vaginam* whenever a condition existed demanding the removal of both ovaries. **Vaginal hysterectomy** may be done either by clamp or ligature. The clamp procedure is the more expeditious. The ligature, while

longer, is safer, and free from the disagreeable odor during convalescence incident to the sloughing tissue devitalized by the clamps.

The operation consists, first, in thorough cleansing and disinfection of the vagina. The cervix is seized with a double tenaculum, and the vagina incised with scissors, knife, or—preferably—with a thermocautery knife. Incision with the latter prevents hemorrhage from the vaginal wall and promotes drainage through the longer duration required in the union of the vaginal wound. The incision completely encircles the neck of the uterus and may extend one-half to three-fourths of an inch on a line posteriorly to the broad ligament. Pus collections in either the tube or Douglas's pouch should now be opened and thoroughly evacuated, and the cavity irrigated before the adhesions are broken up, thus removing an extensive source of infection.

The separation of the bladder from the uterus is accomplished by blunt dissection and the tissues are pushed off posteriorly in the same manner until the peritoneum is reached. By blunt dissection, we may frequently strip out a good portion of the cervix without any necessity for ligating vessels. Having reached the peritoneum in front and behind, a fold of the broad ligament is then secured on either side by ligature or a clamp, and incised, which sets free the cervix. We may now proceed to drag down the cervix, ligate and cut the remaining portions of the broad ligaments on each side in a similar manner, or the cervix may be amputated and the fundus of the uterus rotated downward through the anterior incision. This procedure permits the passage of

the finger over the fundus, to follow up the broad ligaments, and accomplish the enucleation of the ovary and tube. The ovary and tube are usually prolapsed backward from their weight, and this maneuver renders them tense and enables the operator with the finger to follow more readily the line of cleavage between the tube, ovary, and the other tissues.

After the sac is separated and enucleated, the remaining portion of the ligament is ligated and cut. This is usually first done upon the left side, which affords more room to follow the same procedure upon the right. If ligatures are used they should be firmly tied, and the ends cut to prevent traction, which may pull them from the stump. A retracted vessel may be quite difficult to pick up and traction upon the stump may permit the ovarian artery to slip back and cause severe and even perilous hemorrhage. In addition to ligation the stumps are temporarily held with clamps, so that they may not be retracted beyond reach when we desire to close off the peritoneal cavity from the vagina.

The final steps of the operation consist in careful inspection of the wound for bleeding points, irrigation of the wound and vagina with a normal **salt solution**, by which the blood and discharge are completely removed. In the majority of these cases extensive tearing and denudation have been necessary, which will result in the escape of serum or even blood; it is consequently preferable not to close the vaginal wound, but to pack the cavity with iodoform gauze. This gauze packing is permitted to remain from six to eight days. When removed, plastic exudation,

which has been thrown out around it, will hold up the intestines and prevent their prolapsus. It is better, however, to replace the tampon by a smaller one, to remain for a few days. The ligatures should be of catgut.

The vaginal operation is not applicable to all cases. It should not be preferred when there is any hope of saving the uterus and the appendages of one side. Where a partial operation is done, the preferable route will be by the abdomen, which permits one the better to inspect the condition of the peritoneal cavity, break up adhesions, and suitably treat the partially diseased structures to be retained.

Radical surgery in salpingitis should be deferred until after the termination of the acute stage, as operation during the latter involves needless sacrifice of tissue and a higher morbidity and mortality. In all surgical procedures the principle of conservation of healthy tissue is to be kept in view. If the ovary on the side of an extensively diseased tube is unaffected, it should remain. A tube only slightly infected may be opened, milked, and sterilized by injection of a weak **iodine** solution or 25 per cent. **argyrol**. In extensive disease of both ovaries and tubes, however, all will have to be removed, preferably with the fundus and body of the uterus, and, in gonorrheal infection, sometimes also the cervix.

In disease of the ovaries, either alone or with other structures, ovarian conservation may be practised, according to the conditions found, either by liberation from adhesions, puncture of cystic nodules (where cystic degeneration is not pronounced), excision of a cyst-bearing area rather

than the whole ovary, or transplantation of ovarian tissue into the abdominal wall. Where the abdominal end of a Fallopian tube has closed because of chronic pelvic peritonitis, conservation may be practised by **salpingostomy**, the diseased end being excised and its mucosa and serosa sutured together; this procedure, however, is not generally followed by functional restoration of the tube.

TUBAL INSUFFLATION (Rubin Test).—The procedure of trans-uterine inflation to investigate the patency of the Fallopian tubes was introduced by Rubin in 1920, and has an important bearing on **sterility**, which, according to Meaker, is due in 15 per cent. of cases to tubal abnormality. While Rubin has recommended the introduction of 150 to 200 c.c. of carbon dioxide, with subsequent demonstration of its presence in the abdominal cavity by fluoroscopy, Furniss has pointed out that much less than this amount suffices for the detection of tubal patency. A 30 c.c. syringe is filled with the gas from a tank and the gas then injected into the uterus through a cannula with a rubber urethral tip, to fit the external os. A bivalve speculum is first introduced, the cervix grasped with traction-forceps and sterilized with iodine, and the cannula then passed in well beyond the internal os. The vagina is next filled with boric acid solution with a syringe, and connection made between the cannula syringe and a mercury manometer (the latter through a T tube). The boric solution will show any leakage by bubbles. The gas is injected slowly, at a pressure not exceeding 200 mm. Hg. Fifteen seconds are allowed for the pressure to rise from 0 to 100 mm. If the tubes are patent the pressure usually rises to 100 or 120 mm. and then drops to 70 or 80 mm. as the gas enters the abdomen.

Meaker (Boston Med. and Surg. Jour., Feb. 21, 1924) states the figures somewhat differently, asserting that in patency there is usually a sharp drop from 60 to 100 mm. down to 20 to 50 mm. The flow of gas must be very slow at first, to obviate uterine colic, which may offer resistance.

Other positive evidences are auscultatory signs and subjective symptoms. In the absence of these, and if the pressure remains at 200 mm. for 3 minutes, the test is proven negative, *i.e.*, both tubes are occluded. Laparotomy is inadvisable, however, until 6 careful insufflations have been negative. According to the same observer (Jour. Amer. Med. Assoc., June 28, 1924), the procedure also has distinct therapeutic value, especially where the gas passes through with some difficulty. Repeated attempts at insufflation often result in the tubes becoming permeable to gas, and sometimes in conception. Benzyl benzoate having been found sometimes to promote patency by relaxation of tubal spasm, he suggests the taking, in sterility, of 60 drops of the 20 per cent. solution before coitus, with 30-drop doses hourly for 3 doses and after this, every 2 hours for 3 doses.

TUMORS OF THE FALLOPIAN TUBES.

BENIGN GROWTHS.—Benign tumors of the Fallopian tubes are exceedingly rare.

Fibroma, or myoma, of the tube is an infrequent growth, and attains to small size. It arises from the muscular tissue of the tube, and may grow within or become subperitoneal; it rarely obstructs the lumen. Inflammatory and tuberculous changes have sometimes been mistaken for this growth, particularly the condition known as *salpingitis nodosa*.

Recklinghausen has described a form of fibroma characterized by fibroid constituents and including glandular structure. This growth is attributed to vestigial remains.

Fibrocyst of the tube is so rare that but a single case has been described, that of Snger-Barth, which consists of three tumors, the conglomeration of various large cysts, firm tumors that were in part pedunculated from the fimbrie of an otherwise healthy tube, greatly resembling a teratoma.

Enchondromata are small, cartilaginous masses in the fimbrial ends.

Dermoid cyst of the tube is exceedingly rare. Ritchie described one which contained a plum-sized bone. Pozzi has also described a dermoid cyst removed from the tubal wall. Cysts of small size are frequent. The large irregular bulle so common in association with fibroid growths are said to be dilated lymph-spaces. Cysts which vary in size from a pea to a walnut are found in the walls of the tube, but most frequently beneath the peritoneum. Cysts within the tube are generally the result of adhesions of adjoining folds of mucosa.

Polypus is a rarely recognized growth. Lewers reports a case in which the inner surface of the tube was studded with growths varying in size from a pin's head to a pea.

Papillomata of the tube, considered as adenoma by Sutton, are allied to the condylomata, or warts, of the vulva; they consist mainly of epithelium. These growths are difficult to differentiate from sarcoma and cancer, but are evidently benign.

MALIGNANT GROWTHS.—

Carcinoma of the tube may be either primary or secondary, though the latter is much the more frequent. The secondary involvement may take place from either the ovaries or the uterus. Doran divides primary cancer of the tube into two forms: (1) Where the cancer first develops in mucous membrane of a normally formed tube; (2) where it forms in a malformed tube, bearing a cyst whose wall becomes infected.

Sarcoma of the ovary is frequent; of the tube, very rare. Sarcomatous nodules are sometimes found scattered over the peritoneal surface of

the tube, but it more frequently passes from the ovary to the omentum. *Deciduoma malignum* can occur in a portion of the placenta or chorion of the tube. It forms in the tubal sac as readily as it would in the placenta or chorion of the uterus. The possibility of such an occurrence is urged by Sanger as an additional argument for active interference for the extirpation of tubal moles and the appendages after tubal abortion.

TUMORS OF THE OVARIES.

These tumors differ from the other neoplasms in their greater propensity to malignant degeneration, often rendering it difficult to determine whether the individual growth is malignant or benign; consequently we will discuss the two classes of tumors together.

CLASSIFICATION.—Tumors of the ovary are divided clinically into *cystic* and *solid*; pathologically into *simple*, *proliferating*, *dermoid*, and *parovarian*; by size, into *small* and *large*. The cystic comprise the simple, proliferating, and the dermoid. Solid tumors, less frequent, are the fibromata, sarcomata, and carcino-mata. Cysts may originate in any part of the tubo-ovarian structure, as the cortical, medullary, and parenchymatous portions of the ovary, and in the structure between the tube and ovary known as the Rosenmüller organ, or parovarian structure, of which the hydatid of Morgagni, the extremity of the canal of Müller, is an example. Cysts which develop in the folds of the broad ligament are known as broad-ligament cysts.

CYSTS.—Cystic growths attain almost unlimited size, larger than any

other growth, and occasionally the body seems but an appendage to the tumor. They rapidly reach the weight of one hundred pounds. Maritan recently reported an ovarian cyst weighing two hundred pounds, removed from a woman who had previously weighed two hundred and ninety pounds. Her girth measure was ninety inches. Solid tumors closely retain the shape of the ovary; cystic are irregularly spherical,—the larger they become, the more spherical. The surface of the cyst is a bluish white, greenish, brownish, yellow, or a glistening white. Secondary developments in the cyst wall may give it an irregular shape. Cysts are still further divided into unilocular, or single cysts, and multilocular, where the cysts are divided into a number of cavities or smaller cysts within its walls.

The contents of the various tumors greatly differ. Indeed, the different cysts in the same tumors show radically different contents. In the unilocular tumors the contents are usually clear and limpid; in the multilocular, thick, viscid, and glue-like. In some chambers it may be clear and limpid, in others thick and viscid, or, again, mixed with pus, blood, or fat. Cysts of the broad ligament are generally unilocular and contain clear fluid. Those which originate in the hilum are papillary, and those from the parenchymatous structure of the ovary glandular. The small cysts are described as: first, small residual cysts which develop from the horizontal canals of the parovarium, with which may be included the hydatid of Morgagni; second, follicular cysts; third, cysts of the corpus luteum; fourth, tubo-ovarian cysts.

The large cysts are: First, the glandular proliferous; second, the papillary proliferous; third, the dermoid, simple and mixed; fourth, parovarian, including several varieties, as hyaline, papillary, and dermoid.

Small residual cysts develop in the structure between the tube and ovary, known as the parovarian structure, or organ of Rosenmüller. Those originating in the vertical tubes have ciliated epithelium, and may subsequently develop into papillary growths. They are detached from the ligament and hang from the peritoneal surface by a slender pedicle. Attached to the fimbriated end of the tube is generally found a small cyst varying in size from a pea to a cherry, known as the *hydatid of Morgagni*, which from its almost constant presence is regarded as a physiological cyst.

Follicular cysts, or *hydrops folliculorum*, are small cysts which are unilocular, dilated follicles, generally multiple and small. In an ovary which has not attained twice its size, fifteen to twenty of these cysts are often found. They were long considered as the sole source of large ovarian cysts, but it is in rare instances only that they attain the size of a fist, or occasionally of a man's head. The contents of the cyst are generally clear, but may be blood-stained, and have a specific gravity of 1.005 to 1.020. The cyst wall is a transparent, thin membrane of light-gray color, covered with columnar epithelium. The ovarian stroma may be excessive or the reverse. In the latter condition the ovary is frequently converted into a mass of delicate cysts. The disease is generally bilateral. These cysts are unrup-

tured and dilated Graafian follicles. In the smaller ones ovuli may be detected. Failure to rupture and increase of fluid contents produce a dropsy of the follicle. Rupture may be prevented by undue thickness or toughness of the walls which results from inflammation; by deposits of exudation upon the surface of the ovary; by a deep situation of the developing follicle, or by the presence of too slight a congestion, which is insufficient to furnish enough secretion to produce rupture. These cysts have been found in an ovary prior to menstruation; indeed, in the fetal ovary. Being generally associated with chronic oöphoritis and thickened tunica albuginea, these cysts are usually attended with sterility, excessive menstruation, and pain preceding the menstrual flow by ten days to two weeks.

Under the term *perforating hemorrhagic cysts*, the writer refers to the comparatively common "chocolate" cysts, usually small, and occurring during menstrual life. At operation such an ovary may be found adherent to various structures. These cases showed tissue of endometrial type in pockets in the periphery of the ovary about the perforation, and evidences of previous periodic hemorrhages. Material from these hematomas may escape into the peritoneal cavity, leading to adhesions; in addition, adenoma of endometrial type often develops between the adherent folds of peritoneum thus resulting. If invasive, such an adenoma may extend to the uterus, rectum, etc. The author **removes** only the apparently diseased ovary in cases desiring maintenance of ovarian function, provided pelvic invasion is slight. In all other cases, **all ovarian tissues** should be **removed together with** as much as possible of the **pelvic growth**. Sampson (Arch. of Surg., Sept., 1921).

Cysts of the corpus luteum are unilocular cysts the size of a pigeon's egg, occasionally that of an apple. They were described by Rokitsansky, and it was supposed they could only occur in the corpus luteum of pregnancy, but they have been found in the nullipara.

Tubo-ovarian Cysts.—These are produced through the contact and adhesion of a distended tube with a cyst of the ovary. The increasing pressure of the accumulating fluid gradually absorbs the thin septum, and the two sacs form one cavity, the smaller portion of which is usually formed by the tube. The uterine end of the tube can remain permeable and, as the fluid increases, permit the overflow to drain through the uterus. Such a condition is known as a *profluent tubo-ovarian hydrops*, which resembles hydrops tubæ profluens. The open tube acts as a safety-valve and prevents increase from distention of the cyst.

LARGE CYSTS.—Proliferating cysts comprise the great majority of ovarian tumors and vary in size from an egg to that of a tumor weighing over one hundred pounds, which fills up the abdomen and encroaches upon the thoracic viscera. The surface of the cyst presents a pearly white, glistening appearance, the thinner portions of which are purple, green, or black, according to the color of their individual contents. The external surface may be smooth or covered with papillary growths or mucous vegetations. The glandular proliferous cysts are highly organized and rich in vessels, while the *proligerous* cysts have the faculty of budding or generating new cysts from within the original growth. They

may be spherical in shape and regular in outline, simulating a single cyst, or be irregular from numerous nodules, which indicate a multilocular tumor. These growths generally have a distinct pedicle, which is the attachment of the tumor. The pedicle may be long or short, thin and band-like or broad and thick. Occasionally the tumor is sessile. The latter are frequently intraligamentary. The pedicle is developed by the traction of the tumor and the resulting hyperplasia of the ovarian ligament and stretching of the meso-ovarium. The tube generally remains separated by its mesosalpinx from the tumor, while the ampulla is often fastened to or approaches the sac. The tube is usually elongated. In ovariectomy the tube is generally removed with the pedicle. The pedicle varies in length from four to twenty centimeters; in breadth, from two to twelve centimeters, and may be entirely absent. The absence of the pedicle depends somewhat upon the variety of the cyst. In glandular cyst, the tendency is to a long pedicle; in papillary, to short or absent pedicle; in dermoid, the pedicle is short and strong.

Structure.—The internal structure of glandular cysts justifies their division into the areolar, unilocular, and multilocular. The glandular cysts, Virchow said, originate from the invagination or proliferation of the epithelium in the stroma. Continuation of these processes causes the formation of a many-chambered, glandular, or adenomatous cyst. An areolar cyst is a conglomeration of small cysts, with thick, well-developed and vascular stroma. A number of cysts may have ruptured to form a considerable-sized one or

the entire tumor may be made up of a large number of small masses, none of which will exceed the size of a plum. Unilocular cysts often attain an enormous size, but examination will disclose evidence of a previous division into numerous smaller cysts; so it may be asserted that all unilocular cysts originate from multilocular ones. A careful investigation will usually disclose small cysts in the wall, not infrequently the remains of septa in its cavity. Multilocular cysts contain a number of cysts of varying size, so arranged as to present the appearance of a single tumor. By the increase of the individual sacs, their intervening walls gradually become thinned until one after another they rupture, and the sacs coalesce to form larger single chambers. These remains of septa become still more stretched as the tumor increases in size, until they present only a cord-like surface on the inner margin of the tumor. Occasionally the vascular structure alone remains to indicate the former septum. In sudden rupture vessels of the septa are torn and extensive hemorrhage may follow, changing the character of the sac contents. Upon examination of a large cyst we usually find a wall with three layers, the outside consisting of pure connective tissue like the albuginea of the ovary, the middle of loose connective tissue with numerous large vessels, while the inner is rich with cells and contains numerous small vessels. The external surface of the cyst is covered with columnar epithelium, and is lined with one layer of cylinder epithelium, which presents different forms in different tumors, and by its structure governs the character of the secretion in the

various sacs. In the larger cyst the epithelium undergoes degenerative changes, through thinning of the septal wall. Fatty or albuminous changes cause the epithelium to disappear entirely from the wall of one or more of the larger cysts. Pfannenstiel has directed attention to the possibility of the formation of papillary growths in the glandular cysts. These growths may be sparsely distributed from the inner surface of a large cyst; in others they appear as circumscribed tufts in one side of the cyst, while the remaining portion is smooth, or, again, the entire cavity may be filled with strong, branching growths, while the quantity of fluid is very scant. The larger the cyst, the greater the probability that a large portion of the wall is smooth. Cyst contents often present a very great contrast in color and consistence, as almost colorless, a straw color, green, purple or black, thin or thick, viscid or gelatinous. The contents of the various cysts in the same tumor differ in color and consistence; in some the fluid will be thin and in others so viscid that it will not flow. The contents of smaller cysts are more consistent, and become thinner as the cysts increase in size. The specific gravity of the fluid varies from 1.002 to 1.020, with an average of 1.012. The fluid, however viscid it is, is absolutely structureless. It contains blood-corpuscles, epithelial cells, and crystals of cholesterin, while its reaction is neutral or alkaline. Upon analysis, various forms of albumin, metalbumin, paralbumin, and albumin peptone are found.

Papillary proliferous cysts present marked proliferation of the connective tissue, which forms tufts upon

the inner surface of the tumor. These branching projections may distend the sac to bursting; the tufts project upon the outside, and lead to rapid infection of the general peritoneum. Vegetations spring up luxuriously over the surface of the ovary, and are carried to every part of the peritoneal cavity, and not infrequently by aspiration are made to penetrate the diaphragm into the thorax. The contact of the peritoneum with the infection produces extensive ascites. Similar vegetations may arise spontaneously upon the surface of the ovary, and are then known as superficial papillary. These are cases in which a small cyst is opened and infects the external surfaces. Papillary tumors rarely attain a large size, but are generally bilateral. The dendritic growths project in every direction. The projections are reddish or pearly white and glistening, often three or four inches long, and have the appearance of stems of coral. Masses occasionally undergo partial calcification; so they break easily and without bleeding.

DERMOID CYSTS.—These are growths in which are found skin and mucous membrane, with all the structures generally associated with such tissues. The tissues most frequently found are teeth, hair, nails, and sebaceous and sweat glands. Other structures occasionally seen are mammæ, horn, bone, unstriped muscular fiber, and very rarely tissue resembling brain. Fat or sebaceous material at the temperature of the body is generally in a liquid state. Occasionally they are found in solid balls. Sutton reports finding three hundred of these in one sac. In one patient on whom I operated the fluid was filled with

masses of sebaceous material the size and shape of peas. Hair is frequently present in great abundance, and varies in color, length, and quantity. It may be blond, brown, or black, but bears no relation to the color of the individual. Teeth are found in about one-half the cases, and may be loose, fixed, or buried in the wall. All varieties of teeth are found. Schnabel describes a cyst which contained three pieces of bone and one hundred teeth. Plouquet found three hundred teeth. Various bones have been described, as the jaw, petrous portion of the temple, ribs, and pelvic bones, a finger with articulated phalanges, nail and nail-fold, or entire skeleton has been recognized. Dermoids do not always occur alone, but in conjunction with large glandular cysts, the dermoid forming a small part of the mass.

The term **teratoma** is applied to dermoids containing elements of all three layers of the blastodermic membrane. A teratoma often attains to a considerable size, contains the various structures of the dermoids, cartilage, and a large amount of connective tissue. Dermoid growths can appear at any age, have been found in children at birth, and in women of 90 years. The contents of the dermoid sac are exceedingly irritating, and every precaution should be practised to prevent their escape into the peritoneal cavity.

PAROVARIAN CYSTS.—The parovarium, or epoöphoron, is situated in the lateral part of the mesosalpinx and is a remnant of the Wolffian body. Parovarian tumors are almost always cystic and subserous, and consequently have a double wall. The external peritoneal

is easily separable. The pedicle consists of the tube, median ovarian ligament, and the suspensory ligament. Paroöphoron and broad-ligament cysts form about 11 per cent. of abdominal tumors of pelvic origin, and both proliferating and dermoid growths have been found in this situation. They are distinguished from ovarian, first, by the ease with which the peritoneum can be stripped off; second, by the ovary being generally found attached to the side of the cyst; third, by the cyst being unilocular; fourth, by the Fallopian tube stretching over the cyst, never communicating with it; lastly, the gradual thickening of the mesosalpinx.

Solid tumors of the ovary comprise 5 per cent. of the cases presenting themselves for operation. These tumors are benign or malignant, and may become cystic.

Of 488 cases of ovarian tumor analyzed by Briggs and Walker, 439 were cystic and 49, solid. The former comprised: Adenocystoma, 284; dermoid, 44; broad-ligament cyst, 36; papilloma, 24; carcinoma, 50; perithelioma, 1.

FIBROMYOMA.—This is a rare form of benign tumor, yet is the most common species of solid ovarian tumor. The growth is slow and maintains the shape of the ovary. Adhesions are rare.

SARCOMA OF THE OVARY.—

This resembles in form, size, and color a fibroid, excepting that its surface is smoother; its consistence is softer than a fibroid, though it contains much fibrous tissue, making the diagnosis at times difficult to determine. It occurs in the round and spindle-cell forms. The latter predominating, the tumor is more solid and more strongly resembles the fibroid. Spindle and round cells are frequently combined, while myxomatous transformation exists in both

kinds, but cartilage- and bone-formation rarely occurs. Sarcoma combined with carcinoma has been observed in the walls of larger cysts.

Endothelioma and **perithelioma** of the ovary, arising from the walls of the blood and lymph vessels, are clinically like ordinary sarcomas.

CARCINOMA OF THE OVARY.

—This occurs much more frequently than is suspected, and constitutes about 15 per cent. of all ovarian tumors; it is usually primary. Solid ovarian carcinoma is, however, rare, and even when it occurs, undergoes early cystic degeneration. Cystic carcinoma may develop either as a papillo- or an adeno- cystoma, most frequently the former. It is usually multilocular, and tends eventually to perforation, with malignant invasion of the peritoneum. Solid carcinoma may be either of the alveolar, diffuse columnar-cell, or clear-cell type. The largest size attained by solid tumors is that of a man's head.

Case of carcinomatous cystoma that had grown rapidly in 4 weeks. The growth weighed 14 pounds and contained as much iron as 5.6 liters of blood. Engelbrecht (*Zent. f. Gyn.*, March, 13, 1926).

The so-called "Krukenberg tumor" of the ovary is a somewhat rare condition of combined sarcoma and carcinoma, nearly always secondary, oftenest secondary to gastric cancer.

In 111 of the operative cases of cancer of the ovary, single **ovario-tomy** gave a mortality of 24.5 per cent. in 49 cases; double ovario-tomy, 22.22 per cent. in 27 cases, while **hysterectomy** gave only 9.09 per cent. mortality. Of the 59 whose fate is known, all but 11 have died of recurrence. It seems necessary to **remove the lymph-nodes** in the **lumbar region**, as they are

generally involved. G. Massabuau and E. Etienne (*Revue de gynéc.*, xx, No. 3, 1913).

In 23 cases of malignant ovarian disease treated with **X-rays**, over $\frac{1}{2}$ were materially benefited, with no recurrence after 1 year in 1 case, and after 3 years in 2 cases. In 3 cases the cancer was a metastasis of a mammary cancer. One of the much improved patients was a woman of 24 with a sarcoma in the knee and neck, both of which rapidly retrogressed under **X-rays**. Two months later a sarcoma developed in the ovary, which was not modified by **X-ray** exposures or **arsenic**. Later the ovary was removed and injections of the **woman's own ascitic fluid** were given. These induced a febrile reaction with pain in the lower abdomen, neck and knee. Since then she has been well. Orbaan (*Nederl. Tijdsch. v. Geneesk.*, Aug. 21, 1920).

SYMPTOMS OF OVARIAN TUMORS.—Early stages of ovarian tumors produce no symptoms. Occasionally an apple-sized tumor, though movable, may cause unpleasant symptoms, as pain in the sacrum, which extends down the leg. Intraligamentary tumors, or those prevented by adhesions from rising out of the pelvis, produce severe symptoms as soon as they fill the space, especially by obstruction to stool and micturition. In large tumors distress arises from pressure, and interference with the circulation and respiration. The skin becomes stretched and forms striæ, swelling of the navel, hernia, occasionally from pressure upon the great vessels, edema, varicosities in the legs, in the sexual apparatus, and in the skin of the abdomen. Albuminuria, diminution of the urine, and compression of the renal veins are observed. Severe compression symptoms are now rarely seen from large

tumors, as they are generally subjected to early operation. Menstruation is usually unaffected. It disappears comparatively early in those cases in which the follicles perish from the development of sarcoma, carcinoma, and the papillary cystadenoma when bilateral. Menstruation decreases, and the disposition to menopause is betrayed, not from absent ovulation, but as a result of constitutional conditions. Amenorrhea may exist for several years and menstruation return after the removal of an ovarian cyst.

DIAGNOSIS OF OVARIAN TUMORS.—Diagnosis of ovarian tumors is mainly secured by physical signs. The questions to be considered are: First, does the patient under consideration have a tumor? Second, the existence of a tumor recognized, is it an ovarian growth? Third, an ovarian tumor admitted, what are its relations to the surrounding parts? Does it have a pedicle or are there adhesions? Fourth, what is the variety of ovarian tumor? For convenience of diagnosis ovarian growths are divided into two classes: those small, and situated within the pelvis, and the large, or those which rest upon its brim. The abdominal enlargements other than tumors with which an ovarian growth may be confused are: obesity, desmoid tumor of the abdominal walls, ventral hernia, tympanites, fecal accumulation, distended bladder, and ascites.

Alternating, periodical swellings or tumors of the ovary which may be the size of a fist or goose egg may occur. Such patients are sometimes rushed to the hospital where during examination the "tumor" disappears. There may be found a little bloody serum but the tubes and uterus are normal. Or, the menstruation may

come late and persist. A cyst of the corpus luteum may be found, or tumor of the right appendages. After menstruation, the tumor disappears. In one instance the patient came 20 times for examination. In this case the eventual operation revealed extensive adhesions of the appendix and other structures with enlargement of both ovaries. Recovery resulted. But operation is not always necessary; in one instance the cyst burst, with cessation of pain and no untoward results. Ries (Trans. Amer. Med. Assoc.; N. Y. Med. Jour., June 21, 1919).

In *obesity* the history of development, the general distribution of adipose, and the thickness of fat-accumulation in the abdominal wall should be contrasted with the general emaciation which characterizes a large ovarian cyst.

Desmoid tumor of the abdominal wall occurs in the muscle wall, simulating an intra-abdominal fibroid. From its weight, it becomes very dependent; sometimes extends to the knees; is quite movable, very superficial, and hard. Its situation in the wall, its density, and failure to recognize by vaginal or rectal examination any connection with the pelvic viscera should determine its character.

Occasionally such growths spring from the under surface of the abdominal muscles, grow inward pushing the peritoneum before them. I removed one weighing nineteen pounds, which I only recognized as a desmoid when attempting its removal. A careful pelvic examination would have disclosed that it had no connection with the uterus and its appendages.

Ventral Hernia.—The recognition of the coils of intestine, and peristaltic action, through the thin wall, is sufficient.

Tympanites or phantom tumors, a condition similar to pseudocystitis, is sometimes mistaken for ovarian cyst. A loud volume of resonance is easily recognized, and differentiates it from a cyst. It is true that occasionally a cyst may have communication with the intestine, which will permit gas to enter it and thus afford resonance. Even in these cases a sensation of fluctuation is secured which is absent in the phantom tumor. The latter tumor entirely disappears when the patient is placed under an anesthetic.

Fecal accumulation occurs in the colon or transverse portion of the gut, which may descend and lie directly over the pelvis. The accumulations are occasionally quite extensive, but are recognized by their length, by the peculiar sensation under palpation, leaving an imprint under pressure; most of all, by the fact that they disappear with purgatives and enemata.

Distended bladder causes symptoms of a tumor in the lower part of the abdomen, which fluctuates, and may readily be mistaken for an ovarian cyst. The suspicion is apparently confirmed by the history that the patient is passing urine in small quantities or that it is continually dribbling. This, however, should at once cause a suspicion of retention of urine and the introduction of a catheter by which the tumor is dispersed.

Ascites.—With uncomplicated ovarian cysts diagnosis from ascites is not difficult. They have in common enlargement of the abdomen, fluctuation, and symptoms arising from pressure against the diaphragm. Both may be characterized by progressive loss of strength and flesh, more or

less edema of other parts of the body, and an enlarged abdomen. In ascites the abdomen is more or less flattened, its widest diameter transverse, while an ovarian cyst is most prominent in the vertical diameter, and narrow from side to side. Fluctuation over the abdomen is very distinct in ascites and in unilocular ovarian cyst, but its wave extends nearer to the vertebræ in ascites. In the well-filled cyst the projection of the vertebræ prevents the approach of the fluid in the lumbar region. In multilocular cyst the wave is more broken and frequently is only recognized as a sensation of elasticity. Loss of strength is frequently greater in ascites, while emaciation is more marked in ovarian cyst. In renal and cardiac disease there is greater tendency to anasarca.

In very advanced and quite large ovarian tumors pressure may exist, and considerable dropsy of the extremities, but the abdominal distention is in greater proportion. On palpation, ovarian tumor presents greater resistance, and the outline of the surface is more distinctly determined. The abdominal surface can be moved over it. Percussion affords most valuable information. In ascites there is a distinct zone of resonance over the abdomen or part of greatest prominence, while the more dependent portions are dull. The zone of resonance changes with the position of the patient; in ovarian cyst, on the contrary, there is dullness upon percussion over the whole surface of the tumor—resonance only after one has passed beyond its limits, and the line of resonance does not change with the position of the patient. In tuberculous peritonitis and in hepatic dropsy, where the mesentery has

undergone contraction and the peritoneum is very much thickened, diagnosis can be so obscure as to require abdominal incision to determine it. Ascites may complicate an ovarian cyst. By displacement of a layer of fluid the hand will come in contact with the cyst. The amount of resistance will afford information as to whether the tumor is solid or cystic. Complication of a cyst by ascites should awaken suspicion of malignancy or some degenerative process. The greater the amount of ascites, the more probably the growth is malignant. Torsion of the pedicle and death of the cyst will cause extensive ascites. The uterus is freely movable in ascites and an ovarian cyst will be displaced either downward and backward or upward and forward. In ascites arising from rupture of a papillary cyst, a dense, thickened mass upon either side of the uterus should cause suspicion of its true character.

Diagnostic significance is attached by Dienst to the fact that ascitic fluid always contains fibrinogen, which is precipitated by sodium chloride, whereas fibrinogen is never found in the contents of ovarian cysts. If a little fluid removed on tapping is placed in a test-tube and $\frac{1}{3}$ its volume of salt added, a flocculent precipitate will form on standing, after the salt has dissolved, if the fluid is ascitic. If no precipitate forms, it is certainly not ascitic, and exploratory operation should be insisted on. This test is especially useful where fluid in an ovarian cyst resembles ascitic fluid or where chylous fluid resembles cyst contents.

Ovarian tumors are often observed in children. Owing to the relative smallness of the abdominal cavity, a tumor will encroach upon the vital space when it has reached a size which in the adult would scarcely be noticeable. J. A. Cahill, Jr. (*Intern. Clinics*, June, 1924).

Second, is the tumor under observation an ovarian growth? The physical signs vary with the size and situation of the tumor. In its early stage it is entirely within the pelvis, and its position varies. When as large as a hen's egg it falls into the pelvis, where it remains until it attains a size which will no longer permit its accommodation in that situation. Its relation with the corresponding side of the uterus permits its determination by conjoined manipulation. Where the condition has been complicated by peritonitis, the diagnosis may be difficult. Fluctuation or even elasticity does not characterize the smaller growths. It is absent entirely in proliferating cystomata, in dermoids, and often even in single cysts. If we are unable to separate the tumor from the uterus and determine the existence of a pedicle, it can be accomplished by seizing the uterus with a vulsellum while the patient lies upon her back, and with two fingers in the rectum differentiate the borders of the uterus and the relation of the latter to the growth. In small growths the hand over the abdomen and finger in the rectum will generally enable us to outline them. Fibroid tumors of the uterus and inflammatory growths of the tubes are likely to be confounded with small ovarian cysts. Tubal growths are *pyosalpinx*, *hydrosalpinx*, and *hematosalpinx*, the characteristics of which we have already discussed. In *pyosalpinx* the acute history, marked tenderness, existence of inflammatory exudation, and the matting together of the pelvic tissues should distinguish it. A *hydrosalpinx* is generally movable, gives a sensation of elasticity or of fluctuation, but the tumor

is oblong and gourd-like, rather than spherical. A *hematosalpinx* is situated to one side of the uterus, is at first soft, but becomes harder from the coagulation of blood. In the large abdominal growths an ovarian cyst distends the abdomen, particularly at its lower part, rises abruptly from the pubes, and is sharply defined and symmetrically developed. In large single cysts the surface will be smooth and regular, but, in the multilocular, projections and irregularities are found. When made up of a large number of small cysts, it will be more resistant, although it will still present a sensation of elasticity.

Large growths are confounded with pregnancy, hydramnios, extra-uterine gestation, uterine myomata, retroperitoneal growths, and tumors of the various viscera of the abdominal cavity.

Pregnancy.—The enlargement of the abdomen is more rapid, is generally associated with suppression of menses, and the presence of sympathetic nervous phenomena, while in the more advanced stage the patient presents a florid, healthy appearance. Errors are more likely to occur in the unmarried during the early stage of pregnancy. The physician should not be hasty in expressing an opinion, so long as there is any reason for doubt. An examination a few weeks later will dispel uncertainty. As pregnancy advances, fetal movements, heart sounds, and parts of the fetus are recognized. Fetal heart sounds, when heard, are characteristic. Gestation in one horn of a bicornate uterus will make the diagnosis difficult, but a careful bimanual examination will demonstrate the association of the enlargement with

the uterus. Under no circumstances should the length of a uterus be determined by the sound, when there is the least suspicion of pregnancy.

Pregnancy frequently takes place in the presence of ovarian tumors, even though both ovaries be involved. Induced abortion is unjustifiable. Prompt removal of the tumor gives a high percentage of good results in both mother and child. Barrett (Surg., Gyn. and Obst., Jan., 1913).

Most recorded cases of ovarian cyst with pregnancy have been mistaken for hydramnios. Usually the labor was normal. Where operation was performed for oncoming complications the mortality was over 17 per cent.; where performed in a quiet stage, 3 per cent. M. Wetterwald (Schweiz. med. Woch., Mar. 12, 1925).

Hydramnios is a pathological form of pregnancy in which a large collection of amniotic fluid occurs in the uterine cavity. When the collection exceeds two quarts, upon examination for ovarian cyst, the history is of value. Hydramnios comes on suddenly about the sixth or seventh months of a previously normal pregnancy. The physical examination will disclose an enlarged uterus, cervix frequently obliterated, os open, and covered with a dense membrane through which, by manipulation, one may distinguish the parts of the fetus or determine *ballotement*.

Extra-uterine Pregnancy.—An ectopic gestation sufficiently large to permit it to be confounded with an ovarian cyst will present the symptoms of an early pregnancy, possibly indications of rupture of the sac and internal hemorrhage. In advanced stages fetal movements and heart sounds will be heard. Vaginal palpation discloses the fetal parts covered with a thin wall. After death of

the fetus changes will occur which render the diagnosis more difficult. The fetus shrinks, becomes macerated, decomposition in the sac occurs, which renders it resonant, while at the same time fluctuation is distinct. The diagnosis is made by careful analysis of the subjective symptoms and a thorough physical examination.

Uterine Myomata.—Slow growth, resistance of the tumor, presence of multiple growths, irregular contour, and relation to the uterus afford confirmation in the diagnosis. The difficulty may be as great in edematous fibroids and in fibrocystic tumors. Double ovarian cysts, particularly where the pedicle is short or absent, may so drag up the fundus uteri as to make it appear that they are a part of the organ itself. The relation of the uterus to the tumor is best determined by drawing down upon the cervix with a vulsellum, which is held by an assistant, while a second assistant draws up the tumor through the abdominal walls and simultaneously the operator with one or two fingers in the rectum, the hand over the abdomen, seeks the pedicle and determines its relation to the uterus.

In X-ray diagnosis a ureteral stone may be simulated by an ovarian dermoid containing teeth. In the writer's case one roentgenogram revealed a shadow coinciding with that of the visualized ureter, but another, taken from a different direction, showed the shadow 1 cm. away from the ureter. H. Alexander (Zeit f. urol. Chir., xiv, 163, 1923).

Third, the relation of the tumor to the surrounding parts, the character of the pedicle, and the presence of adhesions. The mobility of the tumor is dependent upon the length of its pedicle and the absence of adhesions.

The tumor which can be pushed about without dragging upon the uterus and can be displaced from side to side, the abdominal wall sliding over it, is recognized as free from adhesions and having a long pedicle. Rapid enlargement, tenderness of the abdomen, sensation of crepitus as the abdominal wall is moved over the tumor, indicate recent and extensive adhesions from peritonitis. Limited adhesions of the omentum, intestine, and abdominal wall cannot be excluded.

Torsion of the pedicle is recognized by the onset of sudden and severe peritoneal symptoms, severe pain in the belly, meteorism, vomiting, rapid pulse, and some fever. Rapid growth of the tumor and tenderness of its surface indicate that torsion has been followed by intracystic hemorrhage or increased exudation. Sudden collapse followed by symptoms of internal hemorrhage and peritoneal irritation indicates the occurrence of hemorrhage. Acute torsion is difficult to differentiate from rupture of an ovarian cyst, and peritonitis from perforation of the stomach or intestines, renal or gall-stone colic, ileus, and rupture of ectopic gestation. We can only arrive at a conclusion from careful investigation of the history.

Inflammation of the tumor is characterized by sensitiveness, radiating pain; sudden enlargement and supuration may lead to formation of gas and development of tympanitic resonance.

Rupture of a cyst is recognized by sudden oppression, suffocation, nausea, sometimes vomiting, diarrhea, acceleration of the pulse, moderate elevation of temperature, presence of

free fluid in the peritoneal cavity, and indication of decrease in the size of the tumor, with strong diuresis. Tumor limits are indistinct and there is no alteration of resonance with the change of position.

DIAGNOSIS AS TO VARIETIES OF OVARIAN TUMOR.

—The glandular proliferating cyst is the most frequent, and attains the largest size. They are mostly multilocular, and consequently present a less-marked wave of fluctuation. Fluctuation is an indication of its cystic character and is very distinct in the unilocular and large-chambered cysts. Instead of fluctuation we not infrequently find elastic stretching which can be produced by edematous, solid growths, and enlarged cysts whose contents are made up of colloid or very thick, viscid material. In fluctuating or tough, elastic tumors which are nodular we find a cystadenoma. A large fluctuating tumor is not necessarily a unilocular cyst; generally a small cyst which causes no symptoms is not a cystadenoma, but a dermoid or parovarian, or, more probable still, a simple retention cyst of the ovary.

Dermoid tumors are recognized by their irregular consistency, in some places soft and in others hard. The recognition that the tumor has been in existence for ten years or more will indicate a probable dermoid. Olshausen differentiates parovarian growths by their moderate size, slow growth; thin, relaxed walls; light fluid contents, and very distinct fluctuation. Large cysts are generally multilocular.

Double intraligamentary growths and the presence of ascites with small tumors is a presumption of papillary

growths, but not a positive indication. Superficial papillomata feel firm, nodular, and often extend diffusely into the pelvis. A rapidly developing ascites in which renal, cardiac, and hepatic causes can be excluded should, in the presence of bilateral resistance, awaken a suspicion of ruptured papillary ovarian cyst. Pronounced solid consistence of a growth is common to ovarian fibroid, sarcoma, endothelioma, carcinoma, and teratoma. An ascitic accumulation as a complication is a presumption of malignant trouble. Pronounced cachexia and marasmus may be produced by certain complications, as rupture, torsion, or inflammation; also, in tumors of enormous size. Rapid growth, especially in children, speaks for malignancy. Olshausen has directed attention to early edema of one leg as a symptom of cancer.

ETIOLOGY.—Various theories have been advanced as a cause for the development of ovarian tumors. Cohnheim believed them to originate from retained embryonic products. It was formerly supposed that the dermoid was thus derived, but the diversity of structure found in the dermoid, and especially in the teratoma, precludes the possibility of such origin and favors the assertion that they arise from ovum cells which have been subjected to some special irritation. The variety of irritation, whether mechanical or chemical, animate or inanimate, differs in various kinds of tumors, and is as yet unknown. It is probable that it is chemical irritation which has proceeded by way of the uterus and tubes. Susceptibility for the acceptance of the tumor excitors varies in different individuals, in which the

heredity, acquired disposition, age, trauma, scar formation, and inflammation are important factors. Age has no special significance, though glandular cysts are more frequent between the thirtieth and fiftieth years. All varieties are less frequent in childhood and old age. Ovarian growths are more frequent in the single than in the married.

COURSE.—Proliferating cysts grow more rapidly than either the dermoid or solid tumors unless the latter are malignant. A rapid increase in the size of a growth, noticeable from day to day, is due to hemorrhage. When the pelvic structures are normal, an enlarged cystic ovary will drop by its weight into Douglas's pouch. As it increases in size, it advances in the direction of least resistance, which is upward, and pushes before it the intestines, when it will rise out of the pelvis and impinge against the abdominal wall. It then assumes a central position. The tumor lies directly above the uterus, rests on the brim of the pelvis, and causes but little inconvenience. Occasionally it may become impacted, because of irregularities in its growth or from extensive adhesions. The tumor rests upon the pelvis; as it advances it pushes the intestines upward and laterally. If undisturbed, the enlargement becomes so great that the diaphragm is pushed upward, severe pressure symptoms follow, and the action of the heart and lungs is obstructed. Marked suffering, emaciation, and the development of the characteristic facial expression known as *facies ovariana* follow. The presence of ovarian tumors does not interfere with ovulation and menstruation, even though both ovaries

are involved, so long as ovarian stroma remains. Thornton reports a case of pregnancy with bilateral dermoid disease.

COMPLICATIONS.—Among the complications of ovarian tumors, ascites occurs infrequently with cystic growths, unless from rupture, but is very frequent in the solid. The cause is unknown; it may possibly arise from pressure upon the vena cava or large veins. The edema may enlarge one or both legs. The ureter and pelvis of the kidney may be dilated.

The most frequent complication is the formation of adhesions between the surface of the tumor, the omentum, the intestines, the uterus, the bladder, and the abdominal wall. These adhesions arise from inflammation, as in peritonitis. When not associated with inflammation they arise from loss of epithelium from the surface of the cyst, through friction. Adhesions may become dense, firm, often thread-like, and may convey large vessels between the omentum and growth. Adhesions are frequent in dermoid growths. When adhesions exist between the tumor and bladder, an opening may occur through which its contents are evacuated; openings also occur between the tumor and bowel. Adhesions are of importance because of the increased difficulty in the removal of the growth.

Torsion of the pedicle is a quite frequent complication. It is only when the alteration is sufficient to influence the circulation that it produces disturbance. The right-sided tumor turns to the left and the left-sided to the right. The cause of the torsion is unknown. Küstner as-

cribes it to peristalsis and the varying distention of the rectum; Carrio, to sudden belly pressure; Mickwitz, to contraction of the transversalis muscle. It is very frequent when associated with pregnancy; may occur also from injury. The twist may involve one or two turns of the pedicle, though as many as six twists have been observed. The tendency to torsion of the pedicle is favored by the existence of a long, membranous pedicle, spherical form of the tumor; still further by pregnancy, labor, and childbirth, through the changing relations of the organ in the abdominal cavity. Torsion is the cause of obstruction of the vessels, in which the thin-walled veins suffer before the more resisting arteries. The pumping of blood into the tumor by the artery and its inability to escape by the vein give rise to rapid increase in the size of the tumor. Fatal result can occur from hemorrhage into the abdominal cavity. Hemorrhage may be arrested, but the nutrition of the tumor suffers; its covering epithelium is lost; extensive adhesions follow between its surface and the omentum, intestines, and parietal peritoneum. Adhesions at first are very loose, subsequently becoming organized. The growth thereby obtains a new source of nutrition. Where the twisting of the pedicle is sufficient to obstruct the arteries, the entire circulation is cut off and necrosis of the growth results. Necrosis is followed by shrinking of the tumor and absorption of its fatty contents; peritonitis may follow, and extensive ascites exist. Peritonitis arising independently of micro-organisms is due to irritation from the presence of a foreign body or the chemical products of the tumor.

Sometimes suppuration of the tumor and pyemia ensue.

Dermoid growths are occasionally found free in the abdominal cavity or in pedicle-like adhesion with other structures. Ileus has resulted from adhesions of the intestines to the tumor or to the pedicle. Torsion infrequently may produce no symptoms. These are usually slight, and can be suspected when the patient suffers a severe pain associated with meteorism, sensibility to pressure, acceleration of the pulse, sometimes singultus, vomiting, and fever.

Inflammation and suppuration of the cyst is a complication which may occur, though much less frequently than formerly, when puncture of the cyst was often practised. Infection may extend by the uterus and tube, or by intestine, particularly where adhesions occur between the latter and the sac. Dermoid tumors are inclined to suppurate, probably as a result of injuries which they undergo during their long presence in the body. The occurrence of inflammation and suppuration is indicated by fever, which varies in intensity according to the extent of infection. The patient experiences but little pain, unless peritonitis is associated. Adhesions to the suppurating tumor may occur and the pus make its exit to the bladder, rectum, or vagina. It is rarely that it is completely evacuated and spontaneous recovery follows. Death usually occurs from pyemia. Rupture into the peritoneal cavity is rapidly followed by fatal peritonitis. Such a tumor opening into the bladder produces the greatest distress, as hair, teeth, and pieces of bone are thus discharged; sloughs are impacted in the urethra, inducing cystitis,

retention of urine, and marked vesical tenesmus. Fragments, when retained in the bladder and coated over with salts, form the nuclei of calculi.

Rupture of Cystic Tumors.—The rupture may occur suddenly as a result of a fall or blow, or gradually from changes in the cyst wall. In papillary growths the pressure of the vegetation causes thinning of the cyst wall, and finally rupture, or the growths extend through the wall of the cyst and on its external surface. Rupture of the cyst can occur into the surrounding viscera, but more frequently into the peritoneal cavity; in a thin-walled cyst it occurs easily, under manipulation to determine the diagnosis, change of position in bed, the act of coition, or vomiting, and occasionally occurs without assignable cause. The effect of the accident will depend upon the character of the cyst contents. In unilocular cysts no untoward symptom occurs beyond excessive flow of pale urine. In single and parovarian cysts recovery may follow rupture. Generally, however, the opening closes and the fluid reaccumulates. In rare cases it is followed by high temperature, rapid pulse, vomiting, pressure at stool, and diarrhea, which indicate the condition of the contents: a kind of autointoxication. In multilocular and dermoid growths rupture into the peritoneal cavity is often followed by infection, rapidly developing peritonitis, and finally death. Rupture of papillary cysts results in infection of the peritoneum and the formation of ascites. Vegetations spring up over the entire cavity. Sometimes an artery is torn in the rupture, and marked hemorrhage with profound anemia follows.

The occurrence of rupture is recognized by disappearance of the tumor, diminution of its size, recognition of free fluid in the peritoneal cavity, peritonitis, collapse, diarrhea, and diuresis.

Ovarian tumor may be complicated with **pregnancy**. It is more frequent in the one-sided, though it may occur in the double-sided ovarian tumor. It can occur with any variety of tumor, though more likely to complicate the slow-growing formations. Numerous cases are recorded where the person carrying an ovarian tumor has run successfully the gauntlet of several pregnancies. The ovarian tumor does not grow so rapidly in pregnancy as does the fibroid. The occurrence of pregnancy will depend upon the size of the tumor. Very large tumors may, with increased size from pregnancy, cause marked dyspnea, requiring interference. The influence upon the labor will depend upon the situation of the growth. The very large growths interfere with uterine contraction, and especially the voluntary assistance. If the tumor rests above the uterus and presses it down in a position of retroversion or retroflexion, it may cause impaction and finally abortion. A tumor situated in the pelvis below the uterus interferes with delivery, and unless it can be displaced its size must be reduced. The passage of the child over the sac of an emptied ovarian cyst may cause such severe traumatism of the latter as to occasion subsequent inflammation and infection.

Degenerative Changes in the Cyst Walls.—The cyst walls can undergo the following degenerative processes: First, calcification; second, fatty degeneration; third, atheroma-

tous changes; fourth, changes due to infarctions.

TREATMENT.—No treatment is now recognized as worthy of consideration in the treatment of ovarian cysts other than their **extirpation**. Puncture or paracentesis was formerly an accepted procedure, but experience has disclosed that it is attended with danger. It is but palliative, and presents the possibility of puncture of a large vessel in the tumor wall, with consequent hemorrhage; infection of the peritoneal cavity by escape of the contents of a papillary cyst or colloid material and infection within the cyst, followed by inflammation and suppuration, are possibilities which should preclude the practice of this procedure.

Ovariectomy.—Extirpation of the tumor is known as ovariectomy or, better, **cystectomy**. Success in its performance will depend upon the care with which the diagnosis has been made, the knowledge the operator has as to the condition of his patient, his dexterity in the performance of the operation, and judicious treatment subsequently.

Ovarian substance should be preserved when some normal tissue is present, thereby avoiding the danger and inconvenience of a premature operative menopause. In a girl of 18 years, the left ovary was found at operation represented by a dermoid in the iliac fossa. The right ovary also contained a yellowish cyst, through the wall of which hair was visible. The left adnexa and right tube having been removed, the cyst on the right ovary, measuring 6 x 4 x 3 centimeters, was resected, leaving about what would correspond to $\frac{1}{8}$ of a normal ovary. P. D. Duncan (Minn. Med., Mar., 1925).

Case in which an ovarian cyst caused no symptoms until following

an attack of measles, when a swelling appeared in the umbilical region, and subsequently discharge of pus from the umbilicus. Operation revealed a suppurating ovarian dermoid and a 4 months' pregnancy, which continued after removal of the tumor. M. Godoy Alvarez (*Medicina*, Apr., 1925).

Of 1028 ovarian tumors, 11 per cent. were malignant. Of the patients with glandular adenocarcinoma 23 per cent. were alive 3 years or more after operation; of those with papillary adenocarcinoma, 70 per cent. Of cases appearing favorable at operation, nearly 60 per cent. survive 3 years. C. C. Norris and M. E. Vogt (*Amer. Jour. of Obstet. and Gyn.*, Nov., 1925).

Indications.—The large proportion of tumors in which malignant complications are found and the danger from injury of the growth and torsion of its pedicle indicate the necessity for early operation. Thus, recognition of the tumor constitutes the indication for operation. Removal of the tumor is seldom contraindicated. Neither age nor fixation of the growth, even with evidence of secondary nodules in the abdominal cavity, contraindicates the procedure. In papilloma, indeed, disappearance of secondary tumors will sometimes follow removal of the primary growth. Nor is gross evidence of malignancy a contraindication; suffering may be reduced and life materially prolonged by operation even where there is advanced malignant degeneration. The only actual contraindications, then, are serious cardiac, pulmonary, renal or thyroid disease, and grave primary anemia.

Case of carcinoma of the ovary which previous to operation had been regarded as a fibroid and received X-ray treatment. At operation the malignant disease was found to have

extended to tissues that could not be removed. After ovariectomy a course of deep X-ray treatment was therefore given, with resulting apparent cure. The case illustrates a risk that is taken in the radiotherapy of pelvic tumors instead of early surgical removal. L. Aubert (*Rev. franç. de gyn. et d'obst.*, Feb., 1922).

Case in which torsion of a cyst compelled surgical intervention in a woman of 85. A second cyst was found on the other side. N. Buendia (*Rep. de Med. y Cir.*, xv, 340, 1924).

The prognosis in teratoma of the ovary is grave. A conservative operation is permissible in the young when the covering membrane is intact and there is no evidence of malignancy. In older women, if there is a suspicion of malignancy, a radical operation should be carried out. W. T. Black (*Amer. Jour. of Obst. and Gyn.*, Sept., 1925).

Technique.—The operation of ovariectomy, as classically performed, consists in: First, the incision of the abdominal wall; second, puncture of the cyst and separation of adhesions; third, ligation of the pedicle and removal of the cyst; fourth, exploration of the remaining ovary and toilet of the peritoneum; fifth, drainage; sixth, closure of the wound; seventh, dressing.

The abdominal incision is made in the median line, about three inches in length, midway between the umbilicus and symphysis. It is made through the skin, superficial fascia, aponeurosis, and deep fascia to the peritoneum. It is generally aimed to make this incision through the linea alba, but in undilated abdominal walls the separation between the muscles may be so slight as to render it difficult. It is preferable to open the sheath of one rectus muscle from the side, draw the muscle over, and incise the posterior fascia along its inner

edge. Bleeding vessels are secured. The peritoneum is then picked up and incised between forceps so as to avoid injuring the sac or a knuckle of intestine which may be situated in front of it.

With the completion of the incision, the pearly-white sac is exposed. It may be explored by inserting the hand and passing it around the tumor, thus recognizing the presence or absence of adhesions. With an assistant pressing the sac firmly against the wall, a trocar to which a long rubber tube is attached may be plunged into the tumor and the fluid carried into a vessel at the side of the table. In the absence of the trocar, a glass nozzle for a fountain syringe, with three feet of rubber tubing, can be utilized: Incision is made with the knife into the tumor wall and the syringe nozzle then introduced. In a properly arranged clinic room no trocar need be employed; the cyst is punctured with a knife while the assistant keeps the abdomen tense. The edges of the incision are seized with hemostats or cyst forceps and drawn out, making the cyst walls serve as a funnel to preserve the peritoneum from soiling by the tumor contents. The assistant makes pressure upon the abdomen so that the cyst as it empties shall be forced toward the abdominal opening. As the fluid is discharged the sac becomes relaxed.

It is the belief of one of the writers (P. B. B.) that the uniformly short incision and puncture of the tumor have no place in the operation at the present time. To eliminate all of the risk from dissemination of the cyst contents, the midline incision should be made long enough to permit of

delivery of the entire tumor. An incision of great length is seldom necessary for the purpose. The average large cyst, by reason of its flaccid state, can be more or less molded and delivered through an incision 6 or 8 inches long.

As the cyst is drawn out, the adhesions are separated; those which are recent and soft may be overcome by pressing against them with a sponge or gauze pad. In this way the adherent intestines are sponged away from the cyst. Where the adhesions are old and firm, scissors or knife may be required to accomplish their separation. Bleeding vessels in these adhesions should be secured with hemostat or immediately ligated. Where the adhesions are very firm and short, so that the intestine lies directly upon the tumor wall, separation will frequently be attended with marked injury to intestine. To prevent this, a portion of the sac wall should be permitted to remain in contact with the intestine, taking the precaution to strip off from it the secreting surface. The adhesions as far as possible should be separated under the eye, keeping a watch for large vessels and avoiding injury to intestines, and particularly to the spleen and liver. Vascular adhesions in the omentum should be at once secured either by clamp forceps or ligature.

In a case of ovarian cyst in a child of 6 years, pain in the left lower quadrant, with slight tenderness, were the only early symptoms, soon followed by distention and greater tenderness. Celiotomy revealed cloudy and bloody fluid in the abdomen and considerable distention of the small intestine. The omentum was held fast to the edge of the pelvis by ad-

hesions posterior to the adnexa. When these adhesions were freed, the constricting effect of the omentum on the intestine above was relieved. Pelvic exploration revealed a mass about the size of a lemon on the left side, gangrenous and already becoming necrotic in parts. The pedicle had become twisted 4 times, strangulating the Fallopian tube as well as the ovary. H. T. Wilson (Tex. State Jour. of Med., Aug., 1923).

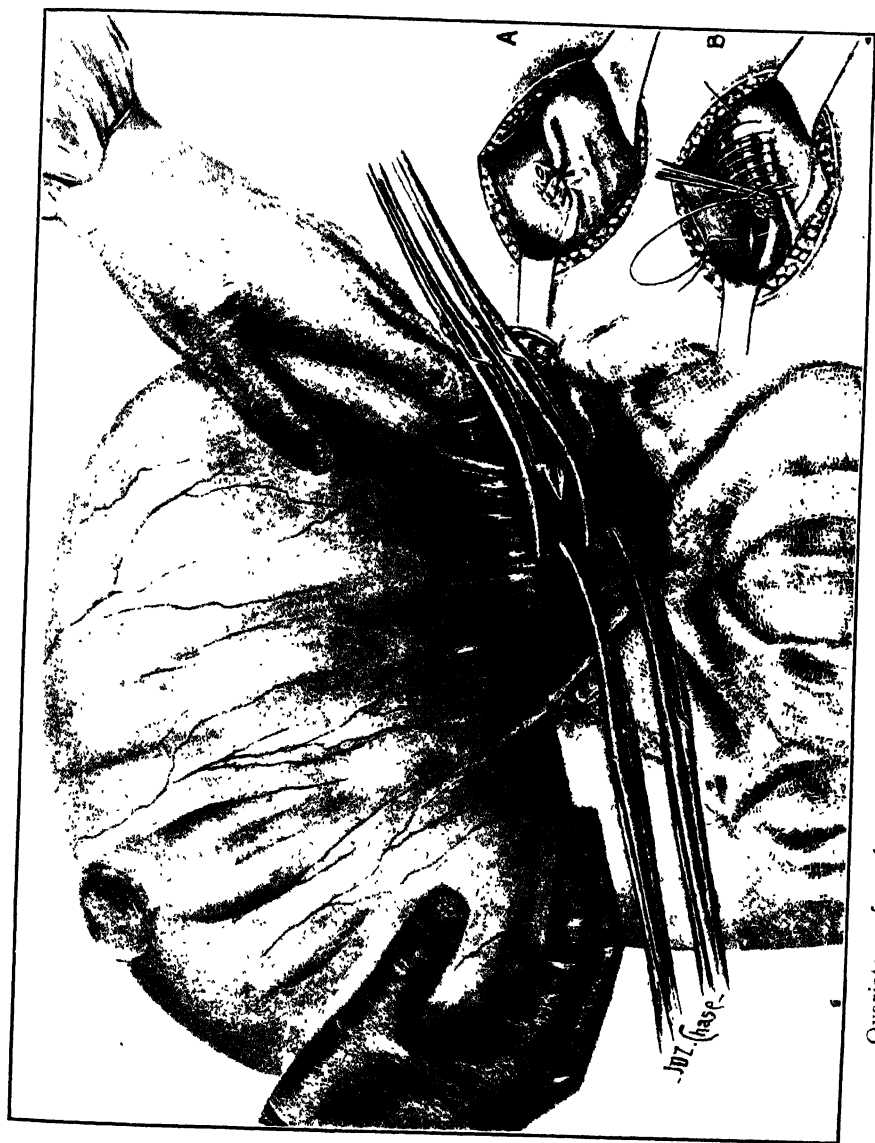
Ligation of the Pedicle and Removal of the Cyst.—Ligation may be accomplished with silk or, preferably, chromic catgut. A long, slender pedicle is transfixed in the center and ligated in two portions. Thicker, shorter pedicles may be ligated in several sections, or the pedicle may cut through, using clamp forceps to secure it and the vessels be ligated separately. With ligation of the principal vessels clamp forceps are removed and the surfaces carefully observed for further bleeding. If possible all the raw surfaces are covered with peritoneum. Where the pedicle is ligated in sections, the sutures should be interlocked to prevent their tearing below, which might cause serious bleeding. In large cysts, for the withdrawal of the cyst the pedicle is seized with clamp forceps and the cyst cut away as a preliminary to the ligation.

Having secured the pedicle, the condition of the other ovary is investigated and the toilet of the peritoneum effected. The investigation of the remaining ovary is important for the reason that not infrequently a smaller cyst will necessitate a subsequent operation. Small cysts in the ovarian structure may be resected or the cysts punctured with a thermocautery. Where an ovary can be saved it should

be done. Even in large tumors, a functioning portion of the ovary can in many instances be saved. The next step is the thorough investigation of the peritoneal cavity, looking over the points at which separation of adhesions has taken place, in order to make sure that no vessels of large size are bleeding. The peritoneal cavity should be cleansed of blood and cyst contents. Where there is much denuded surface or soiling has occurred from a dermoid or suppurating cyst the cavity should be irrigated with normal salt solution. It may be filled with this fluid and the wound closed. All bleeding vessels, however, should have been ligated.

Drainage.—The question of drainage is no longer considered important. Formerly it was the custom to drain in the majority of cases. Later experience having taught the remarkable power of the peritoneum to protect itself, drainage, aside from a vaginal wick, is now rarely employed. The gauze wick has supplanted the glass drainage-tube. Where there has been widespread denudation of the pelvic peritoneum, associated with oozing, the gauze tampon may be used. It should be borne in mind, however, that simple stripping of the peritoneum from the bowel is easily remediable by reperitonizing the raw surfaces with sutures of plain or fine chromic catgut. Where drainage is used, the drainage is favored by placing the patient in the Fowler, semi-sitting position, while the elimination of infectious products is promoted by continuous rectal instillation of salt solution (Murphy proctoclysis).

Closure of the Wound.—The principle of closing the wound is to bring



Ovariectomy for a large adenocystoma. Clamps are applied to the pedicle of the growth and between these the pedicle is incised. The small illustration designated *A* shows the pedicle ligated in sections, with application of a second ligature to the stump. The small figure, *B*, portrays the method of peritonizing the stump of the pedicle (*Bland "Gynecology."*)

and retain the various parts of the wound in their normal relation. Previous to the closure the intestines should be drawn down to the pelvic brim and the omentum placed over them. The closure is effectively accomplished by employing both interrupted and continuous sutures. A good procedure is to employ five layers of continuous chromic catgut sutures, of which four are in the peritoneum, aponeurosis, fat and skin, respectively, to be followed by three, four or more reinforcing interrupted silkworm gut sutures including all the structures of the wall except the peritoneum. These interrupted sutures are not tied in contact with the skin, but over a roll of sterile gauze.

Dressing.—The wound should be washed free from blood and alcohol, dried with sterile gauze, and dressed with several layers of the latter covered with a cotton and gauze pad, held in place by tapes attached to pieces of plaster which are placed on either side of the abdomen. Finally the dressing is maintained in place by a well fitting binder.

After-treatment.—The patient is kept quiet in bed, carefully moved from side to side to render her detention less irksome and to lessen the danger of forming adhesions. Until she recovers from the anesthetic, she is given nothing by the mouth other than small quantities of hot water, concentrated beef extracts, and at the end of twenty-four hours, in an ordinary case, may be given a cup of tea and a little soft toast. This is followed later by an egg, chewing some beefsteak, and at the end of the third day, ordinary diet.

Vernales found **ergot** useful in warding off symptoms from ovarian insufficiency after ovariectomy, espe-

cially the vasomotor disturbances. Denegri has reported fine results from giving in successive 2-day periods **thyroid, pituitary and ovarian extracts** in turn; others, from **arsenic and mineral waters** containing arsenic and iron. The writer ascribes the benefit from these to the regulating action on the thyroid, the latter being always an important factor in the disturbances from loss of the ovaries. Mendoza (*Cronica Medica*, Aug., 1919).

Any indication of accumulation of gas in the intestine is early relieved by the administration of an **enema** consisting of an ounce (30 Gm.) each of **magnesium sulphate, glycerin, and water**. This, if it fails to afford relief, is followed by a large **enema of soapsuds** in which the yolks of two eggs are beaten up in an ounce (30 Gm.) of turpentine and strained, or an ounce (30 c.c.) of tincture of **asafetida** may be substituted for the turpentine, or probably more effective than any is an **enema of a quart (1 liter) of warm water** in which an ounce (30 Gm.) of **powdered alum** has been dissolved. Nausea and vomiting may be overcome by giving **draughts of hot water**, thus **washing out the stomach**; the administration of 2 drops, frequently repeated, of tincture of **nux vomica**, or a combination of **acetanilide and citrated caffeine**. If the patient regurgitates small quantities of dark-greenish material, and this is continued in spite of the large draughts of hot water, the **stomach-tube** should be introduced and the stomach irrigated. The patient should be carefully watched during convalescence by both nurse and physician to anticipate the appearance of complications or abnormal symptoms.

Case of large multilocular cyst with multiple adhesions to the parietes, in

a patient aged 90 years. Tapping had been done at 3-week intervals previous to operation, 16 to 18 pints of thick, glairy fluid being drawn off each time. A good recovery followed removal of the tumor. J. W. Heckes (Brit. Med. Jour., July 11, 1925).

Including complicated cases, the mortality attending ovariectomy is from 1 to 2 per cent. In uncomplicated cases there should be no mortality. The commonest cause of death following the operation is peritonitis. Severe shock from release of intra-abdominal pressure, on which stress was formerly laid, does not occur.

Where it proves impossible, because of dense adhesions, to remove all of the cyst wall, an **incomplete ovariectomy** is performed, the stump constituting the unremovable remainder of the tumor being sutured after destruction of its secreting surface, and dropped back into the abdomen. In some instances a portion of the cyst is **packed with iodoform gauze** and its wall sutured to the anterior parietal peritoneum.

In ovarian cysts occurring in conjunction with pregnancy, all unnecessary chances should be avoided by early operation, just as in the absence of pregnancy. With avoidance of undue manipulation, gestation is seldom disturbed. The most favorable time for operation is the fourth month, abortion being then less likely than in earlier months. The general risk of abortion after operation in uncomplicated cases is somewhat over 10 per cent. It should be borne in mind that an untreated cystoma in pregnancy seriously threatens both the mother and child, 20 to 25 per cent. of such mothers succumbing to one of various complications.

OVARIAN TRANSPLANTATION.

Transplantation (grafting) of an ovary or portion of an ovary of an individual into the body of the same individual is a comparatively simple procedure which may be accomplished, in the majority of cases successfully, by attaching the cut surface of the graft to any well-nourished tissue, such as the parietal layer of the peritoneum, abdominal musculature, subcutaneous tissue, etc. Even a very small portion of an ovary thus successfully grafted preserves the sexuality of the individual and prevents symptoms of premature menopause. On the other hand, transplantation of an ovary from one individual into another, succeeds much less frequently (F. H. Martin).

For therapeutic purposes, according to W. S. Bainbridge (Jour. Amer. Med. Assoc., Oct. 21, 1922), an implantation behind the rectus muscle seems best. For fertilization purposes, when the ovaries have been removed and the uterus is intact, in a woman of child-bearing age, a normal piece of ovarian tissue grafted in continuity with the Fallopian tubes, or at the stump of a tube, if the tubes have been excised, may live, form follicles and ova, and lead to pregnancy. If a homogenous graft is used, the closer the relationship of the donor and recipient, the better, though such relationship is not necessary for purely therapeutic purposes.

According to F. R. Girard (Cal. State Jour. of Med., Jan., 1922), cystic degeneration of the ovaries is no barrier to autotransplantation, and ovaries removed in pyosalpinx patients can be transplanted provided they are not themselves grossly diseased. He cuts the ovarian tissue into disks $2 \times 2 \times \frac{1}{2}$ cm. and places 1 to 3 such disks, without suturing, into a pocket made by blunt dissection between the peritoneum and the under surface of the rectus muscle.

To improve conditions where **infantile genital organs** and **premature menopause** prevented normal functions, P. Sippel (Arch. f. Gyn., May 12, 1923) performed transplantation of ovaries in 57 cases. In 9, the woman's own ovary was reimplanted; this almost always warded off the premature menopause. The results were very satisfactory in 16 of the remaining 48; in 15 no effect was apparent; in 3 the graft sloughed. The effects did not become

manifest from several weeks to 6 months after the grafting. The outlook is promising also in certain cases of **premature senility**. The influence from the autograft generally dies out in from 1 to 3 years; with homotransplants it does not last more than a few months. If no effect is apparent, a second grafting may be successful.

On the basis of 23 operations, Tuffier (Surg., Gyn. and Obst., Oct., 1924) has advocated transposition of an ovary with its pedicle into the uterine cavity after double salpingectomy. In the 23 cases there were no deaths, and the after-results were excellent in 21.

Estes (Ann. of Surg., Sept., 1925), where the tube is permanently obstructed, excises its uterine end and implants the cut surface of the ovary into the resulting denuded area on the uterine horn, thus bringing the ovary into direct relation with the uterine cavity. Pregnancy followed in over 10 per cent. of cases thus dealt with.

Among 118 cases of ovarian grafting, W. Blair Bell (Surg., Gyn. and Obst., Dec., 1925) obtained functional results in 98. Among 107 cases in which menstruation was possible after operation it occurred in 71; of the 36 cases in which menstruation did not occur, only 15 developed menopausal symptoms. Among the 11 cases in which menstruation was impossible because of supravaginal or complete hysterectomy, menopausal symptoms developed in 5.

E. E. MONTGOMERY

AND

P. BROOKE BLAND,

Philadelphia.

OXALIC ACID ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$).—

Oxalic acid is a caustic and corrosive poison obtained from sugar, from sodium formate, and from cellulose. It occurs as transparent, monoclinic crystals (resembling Epsom salts), having a strong acid taste. It is soluble in water and in alcohol, and slowly soluble in ether. As it resembles magnesium sulphate, it may be readily mistaken for it, and since it may be easily procured either as oxalic acid or as salt of sorrel or essential salt of lemon (potassium binoxalate— KHC_2O_4) to remove ink-stains or iron-rust, to scour

metals, to clean wood, or for use in photography, it is not infrequently taken by accident or with suicidal intent. Common sorrel (*Oxalis acetosella*), containing potassium binoxalate is sometimes used in infusion as a cooling drink or as an ingredient of salads; but such use is not to be commended, as danger lurks therein. Fatal poisoning from sorrel has occurred.

The dose of oxalic acid (unofficial) is from $\frac{1}{4}$ to $\frac{3}{4}$ grain (0.015 to 0.045 Gm.) well diluted in water; this may be repeated every three or four hours.

POISONING BY OXALIC ACID.—

When oxalic acid in substance or in strong solution is swallowed there is felt a hot, burning, acid taste during its passage downward, followed by pallor, clammy perspiration, violent prostration, intense abdominal pain, usually with vomiting of a dark-colored matter or even blood. If the poison be diluted, the vomiting may last a long while. In some cases, however, vomiting is absent; in others it is incessant until death.

The mucous membrane of the mouth, tongue, and throat is whitened, appearing as though it were bleached. More or less severe functional disturbance of the kidneys usually occurs, and in severer cases marked uremic convulsions not infrequently appear. The urine frequently abounds in oxalates, and glycosuria may be present. After recovery from poisoning, spasmodic twitchings of the facial muscles, temporary loss of voice, and numbness and tingling of the legs have been observed (H. C. Chapman). Fry ascribes many of the symptoms to reduction in the calcium content of the tissues by the precipitating action of the oxalic acid, and mentions convulsions, twitchings, muscular weakness, fall of blood-pressure, cardiac weakness, changes in strength of pulse due to an increased susceptibility of the vasomotor nerve-endings to epinephrin, cerebral excitement, neurasthenic states, skin eruptions, vomiting, and constipation, as indicating calcium salts. The acid generally does its work quickly, and the corrosive symptoms are replaced by those of fatal collapse. When diluted sufficiently, so as to show no corrosive action, the acid is still highly poisonous, acting as a paralyzer of the heart (Fos-

ter). The minimum fatal dose, according to Taylor, is 1 dram (4 Gm.). Death may take place very quickly or may be delayed for several days.

Treatment of Poisoning by Oxalic Acid.

—To be efficacious, the treatment should be prompt and assiduous. After evacuating the stomach by **emetics** and **siphon** or **stomach-pump**, **chalk** (**calcium carbonate**), **magnesia**, and **plaster-scrapings** from the wall should be given, well stirred in water. Alkalies and their carbonates should not be given, as the salts formed are soluble oxalates. Should collapse appear, the patient must be kept in a **prone position**, **external heat** applied, and **circulatory** and **respiratory stimulants** given.

THERAPEUTICS.—Poulet proposed the use of this drug in **asthma**, **capillary bronchitis**, and **tuberculous bronchitis**, but it is seldom employed. W.

OXALURIA.—This signifies a persistent excess of calcium oxalate in the urine. Calcium oxalate may occur as a sediment either in acid or alkaline urine, but most often in the former, where it is frequently associated with uric acid deposits; in alkaline urine its most frequent associate is the triple (ammonio-magnesium) phosphate. Uric acid may be oxidized to oxalic acid. A few crystals may occur in normal urine after standing for a long time. Transient oxaluria may follow ingestion of acid fruits or foods containing oxalates (cacao, tea, pepper, sorrel, spinach, rhubarb, etc.). Calcium oxalate is also excreted in excess when an excessive diet of flesh and fat is used. The ultimate source appears to be nucleins and nucleo-albumins. Oxaluria is often associated with marked dyspepsia and hypochondriasis or neurasthenia, dependent upon disturbed metabolism; in gouty cases; in wasting diseases, as in tuberculosis, diabetes mellitus, and cancer; in catarrhal jaundice, spermatorrhea, and with "mulberry calculi"; and in general paresis of the insane.

Detection of Calcium Oxalate.—Calcium oxalate appears as a sediment in 2 forms—oftenest as minute, regular, highly-refracting octahedra; more rarely as hour-glass- and dumb-bell-shaped crystals. The octahedral crystals have 2 crossed axes, giving a star or envelope appearance. Presence

of calcium oxalate is not necessarily an evidence of its increased excretion, but may be due to absence of the acid phosphates which normally keep it in solution.

OXYGEN AND OZONE.—Oxygen was discovered in 1774 by Scheele, in Sweden, and Priestley, in England, independently of each other, and described under the names of "empyreal-air" and "dephlogisticated air." The name oxygen was given to it by Lavoisier some time afterward. In the atmosphere oxygen exists in a free and uncombined state (20 to 23 per cent. by volume) mixed with nitrogen. Oxygen-gas is tasteless, colorless, and odorless. It is heavier than air and eight times heavier than hydrogen. When liquefied under pressure, it has a bright, sky-blue color, has a specific gravity of 1.13, an acid reaction, and a temperature of -312° F. (-191° C.). Upon exposure to the air, reversion to gaseous oxygen is very rapid. Water is a combination of oxygen (8 parts) and hydrogen (1 part) by weight. Under certain conditions it appears under the allotropic forms of ozone and autozone.

PREPARATION.—For experimental purposes oxygen may be obtained by mixing finely powdered black manganese oxide (1 part) and potassium chlorate (4 or 5 parts), heating the mixture in a flask or retort, and receiving the gas in an inverted jar over water. All the oxygen comes from the chlorate, the manganese remaining quite unaltered. Although the process is very simple, certain precautions should be observed if the gas is intended for inhalation. The manganese oxide should not contain any combustible matter, or an explosion will result; a small portion should be first heated in a metal cup, should there be any doubt of the purity of the manganese. The first portions of gas should be allowed to escape, as they are contaminated by the atmospheric air of the apparatus and a little chlorine. The gas as evolved should be passed through three or four wash-bottles containing water, and to the first of these should be added about $\frac{1}{2}$ per cent. of caustic potash (to absorb any free acid), to the second about $\frac{1}{2}$ per cent. of silver nitrate (to absorb any free chlorine). The

last washings should be with pure water. The gas may then be collected in a suitable gasometer and kept for a short time, or in rubber bags if wanted for instant use. Oxygen is now made on a larger scale, commercially, directly from atmospheric air, and is sold at a very low rate, delivered in steel cylinders, generally compressed so that a cylinder containing one hundred to two hundred gallons is of a convenient size for handling. From these cylinders the gas is drawn off into a gasometer or rubber bag, for office use or for single administration.

PHYSIOLOGICAL ACTION.—Pure oxygen, *when inhaled*, is irritating to the air-passages; small animals confined in it are seized with convulsions and die in a few days from intense congestion of the lungs. Bornstein, from personal experiment, concluded that man can stand oxygen at a pressure of two atmospheres for twenty or thirty minutes without harm. When a moderate amount is inhaled in health, no irritation occurs; after the inhalation of from 4 to 8 gallons of pure oxygen, there is an increased activity of the circulation with some nervous exhilaration. The respirations are apparently unaffected. Slight giddiness may be present for a few moments, but no vertigo nor headache. In addition to the acceleration of the pulse there are evidences of increased oxygenation of the blood in the lips and finger-nails and in cicatrizing wounds, with granulation tissue. Salvetti, Kollman and others note a diminution in the amount of uric acid, owing probably to the fact that a greater quantity is oxidized in the system. The digestion and appetite improve and assimilation is increased. Like all stimulants, oxygen first excites and then depresses. It must be borne in mind that oxygen can only be taken up by the blood in definite quantities, for it forms a chemical compound with the hemoglobin known as oxyhemoglobin. In overdose the pulse becomes rapid and strong, the blood-pressure being raised, and then spasmodic contractions of the extremities appear. A deficiency of oxygen, according to Kuhn, Aldenhoven and others, is a potent stimulus, for the production of new blood-cells, and a slower increase in hemoglobin.

When oxygen is administered in the form of the *oxygen bath* (90° to 95° F.—32° to 35° C.) Baediker has found that the most important effect is the lowering of high blood-pressure. In persons with normal or low blood-pressure, the changes were very slight. Where the blood-pressure was markedly reduced there was a coincident diminution in the size of the heart (1 to 2 cm.). When the blood-pressure remained unchanged the cardiac dimensions were not appreciably altered. When the blood-pressure was lowered, the pulse rate declined and respiration improved in rate and quality. These effects persist only a few hours after the first bath, but after from 15 to 20 baths very prolonged and even permanent physiological and therapeutic effects were observed.

When oxygen is used in the *liquid form* it produces refrigerant effects when applied to the skin—from a stimulating coldness and local anesthesia to congelation with vesiculation of the surface—varying with the length of application (three to thirty seconds). In addition there is a germicidal action resulting from the use of pure oxygen in its most concentrated form. As a freezing spray it is quicker and more positive in its action than those now in use; it produces a much lower temperature than carbon-dioxide snow; it is more stable than liquid air, and is a non-toxic germicide.

When oxygen is given by *subcutaneous injection*, it acts as a general and local tonic, and increases the elimination of waste matters. The region injected swells and the gas gradually disappears by absorption in from two to twenty-four hours.

THERAPEUTICS.—Oxygen—whose physiological action is too well known to warrant repetition—may be administered in medical or surgical practice in various ways: by *inhalation*, either pure, mixed with atmospheric air, nitrous oxide, ether, chloroform, or other substance; by *infusion* into the pleural or abdominal cavity; by *injection* into tuberculous joints or into abscess cavities, carbuncles, furuncles, etc.; by *subcutaneous injection*; by *local application* of a stream of gas or in solution as oxygen-water, liquid oxygen, etc.

Uses by Inhalation.—Inhalations of oxygen gas are, in a general way, indicated in conditions where there is a deficiency of oxygen in the blood, manifested by symptoms of **asphyxia**, **dyspnea**, or **disturbed nutrition**, or when there is some **functional disturbance of or impediment to respiration**. In cases in which the hemoglobin is already almost saturated with oxygen, as normally, benefit from oxygen is largely limited to increase of the oxygen dissolved in the blood plasma. This plasma oxygen varies directly with the percentage of oxygen in the alveolar air. An increase of plasma oxygen is serviceable mainly where the hemoglobin cannot function properly, as in **carbon monoxide poisoning** and **anemias**, as well as in cases in which the tissue demands for oxygen are greater than can be met by the hemoglobin, as in **heart disease** and in extreme muscular exertion.

Inhalations of oxygen prove very useful in the second and third stages of **pneumonia** when there is present a deficient aëration of blood (cyanosis and dyspnea), with consequent heart distention. It has become clear that the ordinary funnel method of giving oxygen is practically useless, nearly all of the gas being wasted and the alveolar oxygen very little increased. Administration through the nasal catheter was introduced during the World War, has been widely used since, and has proven adequate, except in extreme anoxemia.

Bourne uses in **bronchopneumonia in children** a catheter fastened to the head with a circlet of webbing or elastic and an adjustable aluminum rod, the catheter being lubricated with 2 per cent. procaine in vaseline and inserted to the posterior nares, without touching the posterior pharyngeal wall. The rate of oxygen flow is estimated from the bubbles made in passing through brandy or water in a Woulffe bottle, and need not exceed 70 to 80 bubbles a minute. Such administration can be kept up indefinitely without irritation. Cyanosis is prevented and sleep is not interfered with.

Oxygen chambers, bed tents and head tents for use in pneumonia have also been described.

Oxygen inhalations are also beneficial in **advanced bronchitis**, especially in old

persons. In **stenosis of the larynx**, **croup**, **diphtheria**, **emphysema**, and in **edema or marked congestion of the lungs** the dyspnea is greatly relieved.

Rudolf advises trial of oxygen in all cases of **cyanosis**. It is also indicated in **mountain sickness**, sickness from **high flying**, **poisoning by carbon monoxide**, **nitrites**, and **arsine**, and in the effects of **war gases**. The giving of the gas through a rubber tube inserted into one nostril is made more effectual if the opposite nostril is rhythmically compressed during inspiration, the mouth being kept closed.

Barach has described an effective apparatus consisting of a rubber mouthpiece connected with a rebreathing bag through a canister of soda lime. The patient breathes oxygen through his mouth and room air through his nose, forming a proper mixture, while wastage of oxygen is reduced by the rebreathing. Barach mentions as indications **pneumonia**, **acute cardiac failure**, **severe hemorrhage**, **epidemic encephalitis**, **complications of chronic cardiac insufficiency**, **pulmonary edema**, **acute bronchitis**, and **nitrous oxide** and other **anesthesia**. An air mixture containing 40 to 60 per cent. of oxygen is best.

Oxygen inhalations are useful in the resuscitation of persons **asphyxiated by coal-gas**, **sewer-gas**, **hydrogen sulphide**, **carbon monoxide** and **dioxide**, and **chloroform vapor**. Oxygen is useful in **aniline poisoning**, and to antagonize the **disturbances caused by rarefied air** (Aron). A convenient instrument for prompt resuscitation in these various disorders is the "pulmotor." The operator applies a face mask connected with the storage cylinder, and turns a key. The apparatus then deals out the oxygen in measured quantities and insures its penetration into the lungs.

In **simple anemia**, in **pernicious anemia**, and also in **leukemia** oxygen inhalations have been followed by great improvement.

As a stimulant inhalation and as a nervous sedative, inhalations of oxygen gas (60 parts) mixed with nitrous-oxide gas (40 parts) have been highly commended.

Combination of oxygen with nitrous oxide or the vapors of ether or chloroform tends to decrease the risks and reduces the **vomiting**, **pallor**, and **post-operative depression**.

Oxygen Baths.—Oxygen baths have been found useful in **cardiac disorders with hypertension—arteriosclerosis, aortic insufficiency, chronic nephritis, asthma, Basedow's disease**—in which they have been found to reduce the limits of the dilated heart, to lower the blood-pressure, and to improve the rate and quality of the pulse and respirations. They are *contraindicated* where the blood-pressure is much below normal, especially if associated with mitral defects or profound anemia.

In **functional neuroses—neurasthenia, hysteria, motor excitability, and neuralgia**—they exert a sedative effect, a feeling of well-being and sleep, and in some cases exhibit marked analgesic properties.

Internal Administration.—Oxygen-water is made by charging cold distilled water with oxygen-gas under pressure. It is bottled in siphons (preferably) or other strong bottles, under a pressure of 150 to 200 pounds. When wanted for use it is drawn off by pressure on the siphon lever, or if in bottles, with a champagne-tap.

The use of oxygen-water is advised in **chronic dyspepsia**, and in **headaches of digestive or neuralgic origin**.

In general **systemic torpor** 1 or 2 tumblers of oxygen-water after meals will prove beneficial.

Subcutaneous Injections.—These have been found by Lope (Revista Med. de Puebla, Mex., Dec. 15, 1918) to recall to life many patients otherwise beyond relief; among these were cases of **asphyxia, operative or induced pneumothorax, pneumonia**—all in which dyspnea was intense and failed to be aided by inhalations. From 150 to 200 c.c. are injected with a Pravaz syringe connected with the tank, interposing if possible a graduated jar containing water, into which the gas needed is allowed to flow. Others have used injections of oxygen in **bronchopneumonia, pertussis** and other dyspneic disorders.

Local Uses.—Stoker describes the local treatment of **ulcers and wounds** by the direct application of oxygen-gas. For this purpose he states that the oxygen may be diluted with pure air according to the requirements of each case. It is not necessary that an absolute vacuum over the parts treated should be produced. An oval rubber receptacle or cup covers the

part to be treated and the gas is supplied to it from a rubber bag by means of tubing. Pure oxygen causes a great deal of pain, but some patients can stand it well.

In oxygen we have an excellent body for combating **surgical infections** without at the same time injuring the cells. Thiriar leads the gas directly over the raw surfaces and into the infected tissues, so as to bring about a continuous oxygenation. In the following affections a rapid cure was brought about: In **suppurative arthritis** of the knee, the pus is evacuated by lateral incisions and the gas then passed through the joint; in **purulent and tuberculous peritonitis, in empyema, in gangrene** with the formation of gas, and in **furuncles, carbuncles, and anthrax**. The gas is frequently injected into the dead tissue and the surrounding induration.

Liquid oxygen has been used in a variety of surgical diseases. Bang applies it by wrapping a pledget of cotton around an applicator making a ball about the size of the thumb, immersing this into the bulb of liquid oxygen, and holding it over the surface to be treated for a period of time varying according to the result desired. Healing surfaces should be protected by a layer of gauze, as the cotton will freeze fast to the surface if it remains in contact for more than a few seconds. As a **local anesthetic** it may be used in place of the freezing sprays.

Liquid oxygen has been used with success in the treatment of **furunculosis, suppurating bubo, epithelioma, lupus, ulcers (varicose, traumatic, syphilitic, and tuberculous), gangrenous ecthyma, chancroid, psoriasis, warts (verruca), vascular nevus, and cancer of the tongue**. In **suppurating glands or cysts** that are breaking down, the pus-sacs may be frozen after exposure, and the sac and contents removed *en masse*. In **leg ulcers**, applications of liquid oxygen will promptly convert foul, indolent sloughs into clean, granulating surfaces. A single application will often remove warts.

For the local uses of oxygen in solution see HYDROGEN DIOXIDE.

OZONE.

There has always been quite a considerable discussion concerning the nature of ozone, but the consensus of opinion is that

it is an allotropic or modified form of oxygen. It was discovered in 1839 by Schönbein, of Basle, who noticed that dry oxygen, or atmospheric air, when exposed to the action of a series of electric sparks, emitted a peculiar and somewhat metallic odor, resembling that of phosphorus, chlorine, or sulphur. This odorous principle (electrified oxygen) he called ozone.

Ozone is a colorless gas, having a characteristic odor. It is insoluble in water (pure water will absorb about 8.81 per cent. of ozone, the larger part, however, being converted by the water into oxygen without the formation of hydrogen dioxide) and in solutions of acids or alkalis, but is absorbed by a solution of potassium iodide. It is soluble in oils, some of them taking up as much as 25 volumes per cent. Ozone is decomposed into oxygen by heat, gradually at 212° F. (100° C.), and instantly at 554° F. (290° C.) with an increase of 50 per cent. in volume.

It is a powerful oxidizing agent, and possesses strong bleaching and disinfecting properties. It corrodes cork, rubber, and other organic substances, and rapidly oxidizes iron, copper, and even silver, when moist, as well as dry mercury and iodine. The absorption of ozone by these and other agents is not attended by any diminution of volume. Oxygen when ozonized diminishes in volume (in the proportion of 3 to 2, according to Sorét); when the ozone is decomposed by a metal or other substance, one-third of it enters into combination, while the remaining two-thirds, which is set free as ordinary oxygen, occupies the same bulk as the ozone itself. Ozone may be liquefied by cold and pressure (125 atmospheres), and in that state it has an intense-blue color. Liquid ozone boils at 222.8° to 226.2° F. (106° to 141.2° C.), and if inclosed in a glass tube changes to a blue gas, which again reverts to the liquid state upon being cooled.

PREPARATIONS AND DISTRIBUTION.—Ozone exists naturally, in moderate and variable quantities, in atmospheric air. It is formed during thunder-storms and by silent electrical discharges in the atmosphere. It is evolved during the process of evaporation of water, especially of salt water, and also a result of the respiration of plants, especially those be-

longing to the *Coniferae*. It is therefore found in nature at the sea-shore; in forests, especially in the pine-woods; at the summits of mountains and of high towers. On the other hand, it is usually absent in crowded cities and where organic matter is undergoing slow oxidation, except after a thunder-storm. A great amount of ozone is formed in the mist rising from the cold ground, under a clear sky, on a calm autumn or winter day. Atmospheric ozone, according to Schönbein, is only generated in any considerable quantity when oxygen, moisture, and sunbeams combine, as exemplified and utilized in the bleaching of linens upon the lawn. According to the same authority, under the influence of light the green foliage of plants exhale both ozone and neutral oxygen, both of which are again taken up in part by the growing cells of the plant.

Ozone may be prepared artificially by oxidizing phosphorus in moist air; by the electrolytic decomposition of water; by the slow oxidization of ether, oil of turpentine, and other essential oils; by the action of strong sulphuric acid upon a mixture of potassium permanganate and oxalic acid; by the action of strong sulphuric acid upon barium dioxide; and by subjecting a current of oxygen to the action of the static electrical current.

Although the production of ozone by means of static electricity was discovered in 1839, it was not until 1854 that ozone was obtained in any appreciable quantities by von Siemens. Andrews and Tait discovered that the silent electrical discharge between very fine points would yield the maximum of ozone; and that the intermittent discharge, accompanied by the emission of sparks, caused a considerable amount of ozone produced to be reconverted into ordinary oxygen as fast as it was formed. Von Siemens's apparatus consisted of a modified Leyden jar, made by coating the interior of a long tube with tin-foil, and passing over this tube a second wider tube coated with tin-foil on its outer surfaces. Between the two tubes a current of dry oxygen is passed, which becomes electrified by induction, on connecting the inner and outer coatings with the terminal wires of an induction coil (Ruhmkorff coil) or with a

Holtz static machine. By this means it is said that from 10 to 15 per cent. of the oxygen may be converted into ozone. Von Siemens and Halske have since improved the original apparatus in many ways.

Houzeau's apparatus consists of a glass tube containing within a stout platinum filament, and wrapped on the outside with a spiral of copper wire or other good conducting material. One of the rheophores of the induction coil is connected with the platinum wire, the other with the copper spiral. A current of dry oxygen-gas is allowed to pass through the tube.

The quantity of ozone produced is increased by lowering the temperature, about 50 per cent. of the oxygen being converted into ozone at -88° F. (-31.1° C.). Based upon this principle, W. J. Morton devised an effective machine which is much improved in detail, the output of the machine being measured in milligrams of ozone per minute, and the dosage regulated accordingly.

TESTS FOR OZONE.—In the presence of potassium iodide and moisture ozone will cause the liberation of free iodine (one-third of its volume acting in this liberation and two-thirds escaping as oxygen). Based upon this, test-papers are prepared by immersing sheets of unsized (bibulous) paper into a solution of starch and potassium iodide; these sheets are dried and afterward cut into strips of convenient size. For use one of the strips is moistened and exposed; if ozone be present in the air, it will liberate free iodine, which in turn will act upon the starch, producing a blue color (iodide of starch).

Bibulous paper dipped into tincture of guaiac will turn blue upon exposure to ozone.

Moistened indigo test-papers are decolorized by ozone.

In applying these tests it should be remembered that most of the reagents react similarly to hydrogen dioxide and to ozone, and allowances should be made therefor.

PHYSIOLOGICAL ACTION.—The air contains a minute quantity of ozone, sufficient to act as a stimulant to the respiratory tract. To the absence of ozone in the

air has been attributed many ailments, especially neuroses such as **hay fever** and the "**nervousness**" of which **women** most frequently complain. The fact that such disorders seem to be improved after a thunder-storm has apparently sanctioned this view and led to the use of ozone as a remedy. In concentrated form it causes, when inhaled, inflammation of the respiratory tract and coagulation of the blood in the superficial arteries, though it restores the fluidity of the blood outside of the body. The local effect is attributed to its destructive influence upon the epithelium of the respiratory tract and inhibition of its functions, besides interference with the discharge of carbon dioxide. The toxic effects thus brought about unfavorably affect general metabolism and cause depression of cardiac action.

Hill and Flack found a concentration as low as 1 in each million to be irritating to the respiratory tract, while exposure for two hours to a concentration of 15 to 20 in the million was not without evident danger to life. The cough and headache produced by ozone, however, give ample warning. The respiratory metabolism is reduced by ozone, in concentrations even less than 1 part in the million, and there is no conclusive proof of a preliminary stimulation of metabolism preceding the fall. They found that exposure for ten minutes to 2 parts in 10 millions of ozone may lower the rectal temperature of rats as much as 3° F. (1.6° C.). They explain the beneficial effects from ozone ventilating systems by the effect of the ozone on the nervous system—by exciting the olfactory nerve and those of the respiratory tract and skin.

W. G. Thompson studied the physiological action of the ozone preparations in a series of experiments on dogs. 1. When injected in the circulation in full strength, —i.e., 15 volumes per cent.,—they have a very destructive action upon the blood, thereby ultimately having the effect of reducing rather than of oxidizing agents for the tissues. 2. Acting through the stomach or intestine, they may similarly affect the blood, and in addition they destroy the gastric and intestinal mucous membrane. 3. Given in medicinal doses by

the stomach, their only benefit, if any, consists purely in their local action in the alimentary canal, in possibly preventing abnormal fermentations. 4. If so used, care should be exercised, owing to the great variability in strength of different preparations. 5. Ozone is of no real value to the tissues, whether inhaled or drunk in fluid preparations, and it may be exceedingly harmful.

THERAPEUTICS AND HYGIENE.—

Ozone is utilized in the forms of ozonized air obtained through the use of one of the various special electrical apparatuses or as furnished by nature at the sea-shore, mountains, or in the pines; ozonized water, prepared by charging distilled, sterilized water with ozone by means of special apparatus—or ozonized oil—oil saturated by passing ozone or ozonized oxygen through it.

Ozone is thought to be nature's purifier, acting by prompt oxidation upon decaying, putrescent organic matters, and converting them into harmless products, such as nitrous and nitric acids, water, hydrogen dioxide, and carbon dioxide; but its chief value in medicine is derived from its deodorizing and disinfecting powers.

The writer recommends ozone for **swimming pool purification** for the following reasons: It is reliable as a disinfectant and, unlike the halogens, its use results in no objectionable odor or taste; it improves the appearance and transparency of the water, permitting a longer continued use of the pool; it is cheap, costing in the case of a 60,000 gallon pool only from 11 to 15 cents a day if alternating electric current is available, and where direct current must be converted into alternating current an additional 10 to 14 cents. Manheimer (Jour. Amer. Med. Assoc., June 29, 1918).

In **diphtheria, croup, pertussis, variola, scarlet fever, cholera, and other infectious diseases** ozone generated in the room is said to improve the condition of the patient and minimize the contagion. Vapors of turpentine, eucalyptus, and similar substances will furnish a certain amount of ozone.

Personal experiments by Foulerton and Ransome have demonstrated that dry ozone has no appreciable action on the vitality of micro-organisms; that prolonged exposure does not diminish the pathogenic virulence of *Bacillus tuberculosis* (in sputum), *Bacillus mallet*, or *Bacillus anthracis*; that ozone passed through a fluid medium containing bacteria has bactericidal power; that any purifying action which ozone may have in the economy of nature is due to the direct chemical oxidation of putrescible matter, and that it does not in any way hinder the action of bacteria, which latter are, indeed, in their own way, working toward the same end as the ozone itself in resolving dead organic matter to simple non-putrescible substances.

Jordan, Carlson, Sawyer, Beckwith, and others conclude, in reference to the alleged purification of air by ozone generators, that the amount necessary for this bactericidal action is so great as to affect injuriously human beings.

In cases of **cachexia, anemia, and malnutrition** inhalations of ozonized air have been found beneficial. H. S. Norris observed improvement in cases of **phthisis**, following the use of ozonized water, taken internally. Schmidt reports excellent results following parenchymatous injections of ozonized water in two cases of **epithelioma**. He considers that it may be useful also in **sarcoma and tuberculous growths**. He reports the successful use of ozone-water as a local application in **diphtheria**.

W. J. Morton and C. C. Rice have employed ozone-gas locally in cases of **atrophic rhinitis and pharyngitis sicca** (the patient holding the breath after taking a deep inspiration) by allowing a current of ozonized air to pass into the nostrils through a tube, intermittently. Rice has used ozonized sweet oil (8.75 volumes per cent.) in **ozena**; it thoroughly deodorized the nasal cavities.

In the treatment of **gas poisoning**, oxygen administered by a Haldane face mask, a Stokes intranasal tube, or an oxygen chamber gives excellent results, as evidenced by the disappearance of the clinical symptoms and by the ordinary exercise tests.

The chief symptoms of **anoxemia** are nocturnal dyspnea, with or without sleeplessness, and physical distress out of proportion to the exercise causing the dyspnea. Haldane states that a small degree of anoxemia—deficiency of free oxygen in the blood—has serious results and that such an anoxemia is common. Both theoretically and practically the best method

of supplying the oxygen deficiency is the administration of oxygen. The earlier the oxygen is administered, the greater the chance for recovery, especially if pulmonary edema has developed. Cummins, Douglas, Ryle, Peters, Shufflebotham, Sowry, and Hamill have all obtained similar results with this plan of treatment. W. and S.

P

PANCREAS, DISEASES OF.—PANCREATIC HEMORRHAGE AND PANCREATITIS.—These two conditions are usually considered together owing to their kinship as to symptomatology, pathogenesis, and treatment.

SYMPTOMS.—Although the patient may present a history of gastrointestinal disorder, with uneasiness in the abdomen, attacks of colicky pain, nausea and even vomiting, attributed, as a rule, to mild lithiasis or gastritis, the onset is usually sudden. The attack is generally initiated by intense diffuse pain in the epigastrium which may be constant or paroxysmal, and is intensified by motion and emesis. It is not clearly localized, but radiates from about the epigastrium over the upper portion of the abdomen or to the left of the median line, when the tail of the pancreas is the seat of the lesion.

The pain is by far the most important and persistent symptom. It is very severe, sudden in onset, colicky, and frequently radiates to the shoulders. The most marked physical sign is exquisite tenderness over the entire upper abdomen, with only slight rigidity or none at all. The blood shows leucocytosis with an increase in the polynuclear percentage. C. Eggers (Ann. of Surg., Aug., 1924).

Any degree of deep pressure over the epigastrium causes intense pain, the whole region being exceedingly tender.

Acute pancreatitis is more often unrecognized than it is diagnosed because it is comparatively infrequent while there is no sign or symptom pathognomonic of the disorder; generally the desperate condition of the patient makes operation imperative without the formality of a definite diagnosis. A sudden acute abdominal seizure, overwhelming pain, in an apparently healthy, usually obese individual, accompanied by incessant vomiting, upper abdominal distention, a transverse resistance not easily elicited, weak pulse, subnormal temperature, collapse, and sometimes cyanosis, should suggest acute pancreatitis. The previous history will usually show attacks of severe epigastric pain which have been regarded as gall-stone colic and have been treated as such. Not infrequently the first attack of this kind occurs during or soon after a pregnancy. Deaver (Ann. of Surg., lxxviii, 281, 1918).

In the course of some hours there is usually some swelling of the epigastrium. Any suppuration is accompanied by leucocytosis and sweating. Some jaundice may appear owing to obstruction of the common bile-duct by a gall-stone in the diverticulum of Vater, swelling of the duodenal mucosa, etc.

Nausea and vomiting are early symptoms, increasing in severity, but without relief. The vomitus consists of food and mucus chiefly, but may contain blood in various stages of disintegration. Marked prostration, or even collapse, soon follows. The

temperature is normal or subnormal in cases of hemorrhage without inflammation, and may not be high in the inflammatory cases in which the fever may be preceded by chills. The bowels are usually constipated, but there may be diarrhea.

The disease is usually fatal within a few days. In the exceptions, the acute symptoms gradually subside. The patient may either recover or develop chronic pancreatitis.

Should the patient's life be prolonged peritonitis appears, the pain and tenderness continuing and the abdominal muscles becoming rigid. Marked distention of the abdomen, constipation, a rising temperature, a rapid and thready pulse, intense thirst, delirium, coma then occur in rapid succession, ending in death.

If an abscess occur in the pancreas, it may rupture into the intestine, and cause blood, pus, and pancreatic detritus to appear in the stools, thus denoting necrotic foci in the pancreas.

Case of acute hemorrhagic pancreatitis and a second in which there were only minute foci of fat-necrosis in the interstitial tissue of the pancreas. In the latter case there was a history of recurring attacks of abdominal pain and vomiting, subsiding after a few days, and the pancreas showed signs of chronic inflammation. The temperature was subnormal in both the women; they were 68 and 78 years old and the first died in three, the other in thirteen days. The localization of the pain in the epigastrium and the meager findings on palpation, in contrast to the grave general condition and distress, pointed to pancreatitis. C. Verdozzi (Policlinico, May 1; Med. Sect., No. 5, 1914).

DIAGNOSIS.—Physical examination may reveal a deep-seated swelling, or mass, with tympany on

percussion because of the presence of the overlying stomach and intestine. The urine may contain albumin, casts, sugar, and, as shown by Opie, lipase, the fat-splitting ferment.

Sudden pain in the epigastrium in a well person, or one suffering from occasional indigestion, and early collapse with vomiting, followed in twenty-four hours by a circumscribed resistant swelling, tympany, and tender spots throughout the abdomen, should suggest acute pancreatitis.

In a severe case of acute hemorrhagic pancreatitis there was a confused picture of shock and hemorrhage, so much so that but for the localization of the pain to the upper abdomen and the history of regular menstruation, the diagnosis would have been ruptured ectopic pregnancy. Gillespie (*Lancet*, April 22, 1911).

About 25 per cent. of 70 soldiers in a recent epidemic of mumps presented nausea, loss of appetite and epigastric tenderness, with actual pancreatitis in 1 case. The enlarged and tender pancreas showed vigorous pulsation from the aorta, but not in a second case. It is probable that participation of the pancreas is responsible for the epigastrium symptoms in mumps. Zimmerli (*Correspbl. f. schweizer Aerzte*, Sept. 14, 1918).

Perforating ulcer of the stomach or duodenum may be suspected, but can generally be excluded by a previous history of pain after food, and hemorrhages, and the more general peritonitis that usually follows. *Duodenal cases* may present much difficulty, as perforation may occur without any previous history of pain or disturbed digestion. The symptoms develop suddenly and the pain and collapse may be as marked. Moreover, duodenal ulceration occurs chiefly in the same class as pancreatic disease; that is, in males over 40

years old. *Irritant poisoning* may be excluded by the history and the character of the vomit. *Biliary colic* is excluded by the absence of collapse, and a history of previous attacks; jaundice is likely, but its frequent absence must be kept in mind. *Intestinal obstruction* is the condition most frequently suspected. The onset, however, is less sudden; the distention and tenderness are not confined to the epigastrium, and a tumor may be found at the seat of obstruction. Inflation of the colon, carried out with due care, may determine the seat of obstruction.

Out of 55 cases of acute pancreatitis seen by the writer, gastric ulcer had been assumed in 9 and cholecystitis in 16. In 42 per cent. of the total cases there were complications in the biliary passages. In 2 cases there had been a contusion, and in 3 childbirth had preceded the pancreatitis. Nearly all the patients displayed a tendency to obesity. R. Vogel (Deut. Zeit. f. Chir., Apr., 1924).

Case in which sudden continuous, agonizing pain and rapid, thready pulse were the only appreciable symptoms in a robust young man till death occurred after 8 hours. In a second case, operation at the 16th hour revealed the pancreas hard and triple its normal size, but without fat necrosis or tumor, and the pulse was full and normal. The gall-bladder was drained, removing numerous concretions, with recovery. The only difference noted between the pain of perforation of the stomach and that of acute pancreatitis is that with the former the upper abdomen is hard and taut. In ileus the vomiting is more incessant. Prat (An. de la Fac. de Med., Montevideo, ix, 623, 1924).

Acute pancreatitis is most often mistaken for cholecystitis, peritonitis from a perforated viscus, and acute intestinal obstruction. It is not always possible to differentiate these

conditions. Next to pain, vomiting is the most important symptom of acute pancreatitis, and in the more severe cases it recurs every few minutes. Symptoms of collapse are frequently present. When observing a discrepancy between the intensity of the symptoms and the slight distention and rigidity, together with absence of obstipation, one should at least keep acute pancreatitis in mind, especially when the patient has been apparently healthy, is obese, and has suffered the attack soon after a heavy meal. C. Eggers (Ann. of Surg., Aug., 1924).

As differential points of hemorrhagic pancreatitis, illustrated in his own 2 cases, the writer mentions absence of jaundice in what appeared to be an unusually severe recurrence of gall-stone colic. The pulse was small and rapid, and there was slight fever in 1 case. Tenderness and rigidity were most marked above the umbilicus. There was epigastric meteorism, with signs of fluid in the peritoneal cavity. Considerable dyspnea and restlessness were manifest. Both patients were well nourished. There was no peritonitic facies. Lanfranco (Policlin., Sept. 15, 1925).

ETIOLOGY AND PATHOGENESIS.—Acute pancreatitis or hemorrhage into the pancreas may be caused by many conditions. It may occur during the infectious diseases, especially mumps; as a manifestation of hemophilia or purpura; as a complication of various tumors, of a crushing injury, or a blow on the abdomen, lacerating the gland.

Deaver and most authorities attribute all cases of pancreatitis, acute and chronic, to micro-organismal invasion, even though it be admitted that certain systemic intoxications due to alcohol, syphilis, tuberculosis, or other unknown circulating toxins may produce degenerative lesions which may be classed as chronic pancreati-

tis. The retrojection of bile into the pancreatic duct may, however, initiate an acute pancreatitis of severest type even in the absence of micro-organisms. Infection enters the gland through four portals: By the systemic circulation, through the arteries of supply; by contiguity from adjacent viscera; by ascending infection of the duct from the biliary tract or duodenum; by infection by way of the lymphatics—from the gall-bladder to the pyloric region.

According to Deaver, about 50 per cent. of all cases of pancreatitis are associated with demonstrable disease of the gall-bladder or common duct. In the majority of instances the infective agent in pancreatitis is carried by way of the lymphatics tributary to the pancreas.

Report of 6 cases of acute pancreatitis which contribute evidence to the theory that infection has no direct connection with acute pancreatitis, but that it results from the action of liberated pancreatic ferments on the surrounding tissue. Eggers (Ann. of Surg., Aug., 1924).

Pancreatic hemorrhage is sometimes found as the only lesion at autopsies after sudden death. This condition has been termed *pancreatic apoplexy*. It is probably due to localized inflammation of the gland with autolysis in some cases, and in others to rupture of an atheromatous vessel, with embolism or thrombosis.

It may occur also from rupture of a diseased vessel. Chronic venous congestion caused by heart disease may lead to small, disseminated bleedings. In some grave cases hemorrhage occurs from unknown causes. It may occur with or without inflammation of the gland, owing to digestive action of the pancreatic juice.

Two types of acute pancreatitis of different etiology should be recognized: *Acute interstitial pancreatitis*, due to infection of the interstitial tissue, frequently from the biliary tract through the lymphatics, and *acute pancreatic necrosis* or *acute hemorrhagic necrosis of the pancreas*, due to retrojection of bile into the duct of Wirsung or of the duodenal contents into the duct of Santorini.

Out of 43 necrosis cases, 22 were in patients without gall-stones. The symptoms of this type are sudden, severe, epigastric pain, shock, rapid pulse, subnormal temperature for 2 hours, then a gradual rise to 100° F., cyanosis, usually nausea and vomiting, and leucocytosis up to 15,000. The abdomen contains bloody fluid. Tenderness over the pancreas is always present in the first few days and its careful localization differentiates cholecystitis. Another important sign is tenderness at the left costovertebral angle.

In the interstitial type the treatment is **cholecystostomy**. In necrosis, it is **drainage of the fatty capsule of the pancreas and of the pancreas** itself for 3 weeks. In addition, the **sphincter of Oddi** may be cut or a **choledochostomy** done, according to the patient's general condition and that of the gall-bladder and ducts. D. F. Jones (Boston Med. and Surg. Jour., Mar. 16, 1922).

Acute pancreatitis and pancreatic hemorrhage are more frequent in males than in females, and tend to occur in stout people in whom there is a tendency to gastric or duodenal disorders or gall-stones; childbirth has also been incriminated; pregnancy likewise. Mayo Robson has associated it with a deficiency of calcium in the blood.

The writer's case of sudden death following parturition was due to acute necrosis of the pancreas. The patient was corpulent and somewhat of an alcoholic. She ate very heartily just

before labor began and the latter lasted but two and one-half hours. Soon after expulsion of the placenta she collapsed and vomited, death occurring so soon after that air embolus was suspected. Autopsy showed that the pancreas was the seat of an acute necrosis. There were fresh, toxic lesions in the liver, due apparently to the escaped pancreatic ferments; but there had been no pancreatic hemorrhage. Saenger (Munch. med. Woch., June 17 and 24, 1913).

The hemorrhage may be limited to a part of the gland or it may infiltrate the whole gland and the retroperitoneal tissues, even rupturing into the lesser peritoneal cavity and filling it with blood.

Acute pancreatitis and pancreatic hemorrhage may be complicated with inflammation which not infrequently terminates in necrosis.

As Guleke and von Bergmann had already shown, a preliminary subcutaneous treatment of dogs with trypsin provides protection not only against the toxic effect of larger doses of trypsin, but also against the toxic effect of pancreatic substance introduced into the peritoneal cavity. The experiments of the writers show that the immunity is provided only against a certain amount of the pancreatic substance in the peritoneal cavity. In order to provide further protection, the imbedding of the pancreatic substance into the peritoneal cavity must be preceded by an immunization with increasing doses. These experiments furnish a further support for the view that the toxic effect of the necrotic pancreas does not depend alone upon the toxic effects of its proteolytic ferment. The immunity obtained by preliminary treatment with trypsin and pancreatic substance cannot be transferred to other animals. Joseph and Pringsheim (Mitt. a. d. Grenzgeb. d. Med. u. Chir., xxvi, 290, 1913).

Inflammation may, however, occur without hemorrhage; it then tends rather to suppuration than gangrene. Painful gastroduodenal disturbances have preceded in many cases, the inflammation evidently extending back along the duct. It is thus probable that indulgence in alcohol plays a part in its production.

In the 12 cases described by the writer the patients were nearly all corpulent and passing or past middle age. Gall-stone trouble was a factor in 2, gross error in diet and abuse of alcohol in 1. In 1 case the head was swollen and a few foci of necrosis were all that was found at the gall-stone operation. In 2 other cases the pancreas disease caused death from toxins in less time than usual with peritonitis from perforation. When there is much suppuration the course is generally milder. Rollmann (Deut. med. Woch., April, 1914).

MORBID ANATOMY.—Three varieties of acute pancreatitis have been recognized by Fitz: the hemorrhagic, gangrenous, and suppurative.

In *hemorrhagic pancreatitis* the gland is enlarged throughout or in some part, and infiltrated with blood, the color of which varies with the duration of hemorrhage and the severity of inflammation. A section may show a variegated surface, with opaque white spots due to fat-necrosis. Extensive hemorrhage may be found in the root of the mesentery in retroperitoneal tissue, and about the kidneys, especially the left. In these parts areas of necrosis of fatty tissue are often found.

Gangrenous pancreatitis follows hemorrhagic pancreatitis, but no distinct line of demarcation can be established. The gland or part of it may be converted into a dark-gray mass, wholly or partly separated from its

attachments and lying in the lesser peritoneal cavity or in the cavity of a large abscess. The surrounding peritoneal surfaces become covered with a fibrinous exudate. The sac of the lesser peritoneum may contain a large quantity of dark, offensive fluid in which masses of necrotic fat may be found. Perforation, with discharge of this exudate, may take place into the stomach or duodenum, and recovery follow.

Acute hemorrhagic pancreatitis may be related to the presence of a round-worm in the pancreatic duct. A woman of 30 years was seized with severe abdominal pain, chiefly across the lower abdomen and back, followed by vomiting and shivering. Operated on the next day, she showed a quantity of reddish, odorless fluid, extensive fat necroses of the omentum and mesentery, and a greatly swollen, maroon-colored and mottled pancreas, with its substance soft and spongy. The patient dying the next night, there was found at necropsy an ascaris projecting into the duodenum from the ampulla of Vater, with its body in the pancreatic duct and the duct of Santorini. H. M. Rigby (Brit. Jour. of Surg., Jan., 1923).

In *suppurative pancreatitis* a single abscess or multiple abscesses may form, or there may be diffuse purulent infiltration of the surrounding tissues. Perforation into the stomach or duodenum may occur. Fat-necrosis is rare in these cases. Septic thrombus of the splenic vein may form and lead to infection of the portal vein and multiple abscesses in the liver. The spleen is not usually much enlarged. The pleura and pericardium may become infected by extension of the inflammatory process through the diaphragm. Various bacteria, especially the colon bacillus, are found in the affected tissues.

The ubiquitous presence of *fat-necrosis* in hemorrhagic and necrotic pancreatitis is a striking feature of disease of the pancreas. The condition is rarely met with apart from affections of this organ. It has been produced experimentally by inserting pieces of pancreas beneath the skin or into the subperitoneal fat, and by experiments on the pancreas itself. The areas vary greatly in size, some being as small as a pin's head, others as large as a hen's egg, and are soft.

According to Flexner, fat-necrosis is due to perversion of the pancreatic secretion and the direct result of the action of the fat-splitting ferment.

The factors underlying acute hemorrhagic pancreatitis are not as yet definitely settled, but may be grouped under 4 heads—infection, traumatism, and chemical or pathologic physiology. Trypsinogen exists in the pancreas in an alkaline medium. If this medium is neutralized or acidified, the trypsinogen is activated; this result may be brought about by various chemicals, bacteria or trauma. The abnormal activation of trypsinogen within the pancreas produces fat-necrosis, with damage to the blood-vessel walls, resulting in diapedesis or hemorrhage. T. E. Vass (W. Va. Med. Jour., Feb., 1924).

Acute pancreatitis is not necessarily associated with fat-necrosis and hemorrhage. It may occur as a simple non-suppurative inflammation, with swelling, edema, and tenderness at the site of the organ. Usually the head is the part affected, but the entire organ may be involved. These non-inflammatory cases are sometimes described as pancreatic apoplexy. They are almost invariably associated with disease of the gall-bladder or, possibly, the duodenum. In the majority of cases the infection travels by way of the lymph channels. J. B. Deaver (Med. Jour. and Rec., Feb. 6, 1924).

PROGNOSIS.—Many mild cases probably occur and recover, but severe cases are generally fatal, although Trafoyer has reported an instance of recovery after sloughing of the pancreas and its discharge by the rectum. A fatal ending may be due to collapse and occur within a few days, but cases that recover from the shock may succumb to septicemia some weeks later. Some patients are unable to withstand the initial shock of the disease, and succumb within twenty-four hours. Peritonitis, sepsis, and thrombosis of the splenic vein are all possible modes of termination. Recovery is promoted by early laparotomy to arrest the hemorrhage, evacuate pus, or explore and drain the peritoneal cavity.

The acute pancreatitis of acute infectious diseases, nearly always non-suppurative, is met with in infectious endocarditis, septicemia, pyemia, typhoid fever, diphtheria, scarlet fever, small-pox, undulant fever, and especially mumps. Recovery is the rule, and the signs are rarely such as to demand exploration. While usually subsiding without causing any great damage, acute pancreatitis complicating mumps has been found both at operation and at autopsy. There is sudden severe pain, nausea and vomiting, and tenderness in the upper abdomen. Leukocytosis may be present and marked. Rigidity is usually not marked. The acute symptoms do not, as a rule, last many days. At times, jaundice and clay-colored stools may follow, suggesting that duodenal and biliary infections were possibly associated with, if not responsible for, the pancreatitis. Thomas McCrae (*Atlantic Med. Jour.*, June, 1925).

TREATMENT.—The medicinal treatment is purely symptomatic. The extreme pain and the collapse require the subcutaneous injection of

morphine—in large doses, as these cases are resistant to it—and the administration of **stimulants** by the stomach or rectum, **cold compresses over the epigastrium**, or **hot fomentations**. Frequently nothing short of **chloroform inhalations** will relieve the pain. Circulatory weakness should be met, aside from the stimulants, by **intravenous saline infusion** or **hypodermoclysis**. **Gastric lavage** is indicated for vomiting and dilatation of the stomach. **Blood transfusion** as a preoperative measure may be helpful.

Even when operative treatment is being considered, internal measures should not be neglected. Chief among these are the dietetic, restricting the patient to a **strict anti-diabetic diet**, the advantages of which have been proved beyond question. As a further means to reduce the secretion of pancreatic juice, **sodium bicarbonate** by the mouth during meals has been recommended, but is probably unnecessary unless an operation is impending. **Sedatives** and **stimulants** are indicated. Complete **rest in bed** is necessary, with **ice** over the pancreas at first and later **warmth**, guided by the patient's feelings. The writer has had the best result with **super-heated air**, not going above 80° C. (176° F.). **Washing out the stomach** may also be useful. Patients who have passed through an attack of pancreatitis should be kept under supervision for several years, as the acute pancreatitis may recur or may pass into a chronic phase. Dreesmann (*Jour. Amer. Med. Assoc.*, from *Med. Klinik*, June 25, 1911).

Individuals who have weathered acute pancreatitis in any form are potential diabetics, and must be put upon **prophylactic treatment**. This consists in reduction of the carbohydrates in the food and some attention to the carbohydrate-fat ratio, frequent urine examinations, and especially blood-sugar tests. D. Riesman (*Atlantic Med. Jour.*, June, 1925).

The treatment of the more severe forms of acute pancreatitis is chiefly surgical; the operation should be carried out as soon as the patient's general condition will permit. **Exploration** and **drainage** of the lesser peritoneal cavity and **evacuation of pus**, if any, are life-saving measures when the case has not progressed too far.

Mortality statistics show the need of early operation. In a first series of 16 cases, the writer had a mortality of 62.5 per cent. In a second series, with early diagnosis in 75 per cent. of cases, it was 13.6 per cent.

Operation is indicated in all cases *unless shock is extreme*, and **very rapid operation** is of extreme importance. The pancreas may be exposed: (1) Through the gastrohepatic omentum, which is preferable; (2) through the transverse mesocolon; (3) through the gastrocolic omentum, or (4) in the late stages, through the lumbar region. The operation consists of **multiple punctures** of the pancreas with blunt forceps and **drainage** of the gland with rubber tissue and gauze. The omentum is closed around the tube. Later treatment consists of a strict **antidiabetic diet** and **sodium bicarbonate** to reduce the pancreatic secretion. Linder (Jour. Amer. Med. Assoc., Sept. 1, 1917).

An incision is made a little to the right of the median line, commencing in the epigastric region and extending below the umbilicus. Complete exposure of the pancreas is usually effected by dividing the anterior 2 layers of the great omentum immediately below the greater curvature of the stomach and lifting up the latter organ. Free **incisions** should be made into the swollen pancreas, parallel to its long axis, and all blood clots and serous fluid removed by sponging. Large drainage tubes are passed into the incised area, and the region of the pancreas is packed with a long, wide strip of absorbent gauze. Free drainage must be maintained, as **sloughs** continue to separate for many

weeks. Waring and Griffiths' (Brit. Jour. of Surg., Jan., 1924).

In the ultra-acute form of pancreatitis, death usually ensues in a few hours, the patient never having regained consciousness. **Operation** offers the only hope, and if possible should be carried out without delay. In the less fulminating forms it may be advisable to give a little time for a rally from the initial severe shock, and possibly also to allow the peritoneal inflammation to localize. Shock can be controlled by **saline infusions**, or **adrenalin** and **pituitrin**, so that operation need not be delayed. The earlier the operation the better the prognosis, particularly since extravasation of blood and ferments into the pancreas and surrounding tissues can be forestalled. The operation should consist of **drainage** of the fluid, if the pancreas contains such, or if not, drainage down to the pancreas, in the severe cases. Hemorrhage after operation being not uncommon, deep **incision** should be avoided and the amount of drainage limited. Necrosis of vessels is more liable to occur when they are in contact with drainage. Post-operative excoriations of the skin from the wound discharge, which contains activated pancreatic juice, are best prevented by **protective ointments**. **Diet** is of the utmost importance, for glycosuria is one of the sequelæ of acute pancreatitis. Deaver (Atlantic Med. Jour., June, 1925).

For additional details, the reader is referred to the article ABDOMEN, SURGERY OF, in the first volume.

CHRONIC PANCREATITIS.

SYMPTOMS.—Although the symptoms of chronic pancreatitis are not clearly defined, its presence should be suspected when, in addition to chronic indigestion, there is more or less jaundice, emaciation, and a disposition to diarrhea with large stools. These develop insidiously, the dyspepsia, with anorexia, nausea, vomiting, epi-

gastric distention and flatulence. Pain radiating to the back and deep-seated tenderness and resistance in the pancreatic area may be elicited. Profuse salivation (*pancreatic sialorrhoea*) is occasionally witnessed. Ascites may be caused by obstruction to the portal circulation. Glycosuria develops if the islands of Langerhans are involved.

In chronic pancreatitis nutrition is almost invariably impaired and the patient is emaciated, sometimes to an extreme degree. Digestion is disturbed. There is discomfort after eating, and often this discomfort can be associated with certain articles of food, particularly the carbohydrates. The discomfort does not appear to have any characteristic type. It may be a sense of oppression, fullness, or of actual pain. Vomiting occurs quite constantly, but it may be only at long intervals. It rarely occurs just after taking food unless the patient's condition is very grave, but may occur in the morning or some hours after taking food, and is usually preceded by some hours of discomfort. Constipation is the rule. Sailer (*Amer. Jour. Med. Sci.*, Sept., 1910).

The diagnosis of chronic pancreatitis is more difficult than that of the acute form. The leading and most constant symptom is pain, which varies from dull discomfort or ache to sharp lancinating or colicky pain quite like gall-stone colic. Slightly less frequent than pain is the history of nausea or vomiting or both. A third important symptom is jaundice. Impairment of the pancreatic function results in loss of weight. The bowels are constipated. The physical examination rarely affords much positive information and is of more value in excluding other conditions. The Cammidge reaction, even the improved or "C" reaction, does not render any assistance. J. B. Deaver (*N. Y. Med. Jour.*, March 23, 1912).

By the method of finger-point pressure, advancing gradually from all

sides toward the epigastrium as a center, one is easily able to demonstrate, in cases of pancreatitis, a more or less well-defined area of tenderness in which there will be one or two points of maximum tenderness, usually exactly in the midline, from one to two inches above the umbilicus. There is rarely any superficial tenderness except in the severity of the onset. During the subsiding stage one will frequently have to go moderately deep with the finger before eliciting tenderness.

Another useful diagnostic feature is the presence of tenderness in the left costal space behind, in which situation one comes more or less directly upon the left half of the gland. E. Archibald and E. J. Mullally (*Can. Med. Assoc. Jour.*, Feb., 1913).

The writer found only 2 cases of diabetes mellitus among 250 cases of chronic pancreatitis. In chronic non-biliary pancreatitis there are digestive disturbances with pains in the epigastric region and right hypochondrium, less frequently in the left; a rapid and considerable loss of flesh; an accompanying anemia; a slight suggestion of jaundice; fat in the stools; slight bulging above the umbilicus, and rigid rectus muscles. The head of the pancreas can be felt hard and knobby, possibly tender and tumefied. When the stomach is inflated, the tumor vanishes. Sallis (*Revue de chir.*, April, 1914).

The factors which aid in the diagnosis of pancreatic lesions may be divided into 3 groups: (1) tumor, pain, tenderness, vomiting, cyanosis, and the signs of pressure upon neighboring structures; (2) failure of the external secretion of the pancreas, and (3) failure of the internal secretion of the pancreas. A mass, which is usually movable, may or may not be present in the upper abdomen in pancreatic disease. The pain is often very severe and may be continuous or paroxysmal. Vomiting and severe constipation are also prominent. Jaundice often aids in the diagnosis.

A. F. Garrod (Brit. Med. Jour., i, 459, 1920).

The voluminous stools referred to above are, typically, found to contain undigested muscle fibers (*azotorrhea*), owing to the deficiency of pancreatic juice caused by the lesions in this organ. Visible fat (*steatorrhea*) is also present, but as neutral fat, instead of as fatty acids and soaps, into which fats are normally split by the pancreatic lipase. The large size of the stools is due to the passage of considerable food which, if digested, should have been absorbed. This accounts also for the rapid emaciation.

The examination of the feces is deemed important by Deaver. The typical, large, fatty, diarrheal stool (*steatorrhea*), is very strong evidence of insufficient pancreatic function. This typical stool, however, is present only in late and extensive disease of the organ. Constipation is the rule. Undigested muscle fibers (*azotorrhea*), if marked, possess some significance. The presence of an excess of neutral fat or of both neutral and split fats when stercobilin can be shown chemically to be present in the feces is a point in favor of deficient pancreatic secretion. It is well to note that clay-colored stools do not mean absence of bile, since a large amount of unabsorbed fat and fatty acids will give the same appearance. If stercobilin can be demonstrated chemically it will prove that bile is being discharged into the intestine and that the chief source of the digestive disturbance is the pancreas.

DIAGNOSIS.—Chronic pancreatitis is at best difficult to identify. Cancer of the pancreas, which presents much the same early history, cancer of the bile-ducts, and perigastric adhesions due to gastric ulcer or cancer, are the principal sources of confusion.

Negative findings in a gastric test-meal will help to differentiate pancreatic from gastric disorders.

Of considerable aid are the *meth-*

ods for the detection of pancreatic insufficiency. The *Loewi adrenalin mydriasis test* is performed by dropping 2 or 3 drops of 1:1000 adrenalin solution into 1 eye. The result is positive if mydriasis is observed in $\frac{1}{2}$ to 1 hour.

No one test can be said to be pathognomonic of pancreatic insufficiency. Yet, the association of increased diastase content of the urine, a positive Loewi test, and the presence of glycosuria, afford strong evidence of such insufficiency. If, in addition, there is creatorrhea and steatorrhea, the suspicion is confirmed. Wallis (Quart. Jour. of Med., Oct., 1920).

Description of a test of pancreatic function consisting of the *direct determination of lipase within the small intestine.* A perforated celluloid capsule, with string attached, containing a small capillary tube filled with olive oil, agar-agar and Nile blue sulphate (Einhorn's formula) is swallowed by the patient at night to a distance of 36 inches as measured by the string, and removed after 12 hours. The change in color of the Nile blue sulphate, in millimeters, gives the extent of lipolytic digestion. Buckstein (Jour. Amer. Med. Assoc., Nov. 18, 1922).

The Cammidge reaction, once considerably employed, has been found unreliable; it is given here, however, for the benefit of observers who wish further to test its actual worth:—

Cammidge Test.—Cammidge abandoned his earlier "A" and "B" reactions, and published work on a new reaction, or "reaction C," which he thought gave better results. Reaction "C," as described by Goodman (Int. Clinics, Vol. ii, 19th Ser.), is as follows:—

"A portion of the twenty-four hours' urine or a portion of the mixed night and morning specimens is examined for albumin and sugar. If albumin is present, it is removed by boiling with the addition of a few drops of acetic acid, and filtered. The removal of the sugar will be spoken of later. To 40 c.c. of the filtered, albumin-free, acid urine are added 2 c.c. of

concentrated hydrochloric acid, and the mixture gently boiled on the sand-bath for ten minutes following the first evidence of ebullition. A small flask with a funnel as condenser is used for the purpose. After ten minutes' boiling the flask is removed from the sand-bath, cooled in a stream of running water, and the contents made up to 40 c.c. with distilled water. Eight Gm. of lead carbonate are then added to neutralize the excess of acid, and after standing a few minutes the flask is again cooled in running water and the contents filtered through a moistened, close-grained filter paper.

"At this stage of the procedure, if sugar has been found on qualitative analysis, a portion of yeast is added to the clear filtrate, and the flask placed in the incubator over night. The next morning the solution is filtered and the test is continued.

"The acid filtrate is thoroughly shaken with 8 Gm. of tribasic lead acetate and the precipitate removed by repeated filtration through a well-moistened, close-grained filter paper. To get rid of the excess of lead, 4 Gm. of powdered sodium sulphate are added, the mixture heated on a wire gauze to the boiling point, cooled in running water to as low a temperature as possible, and the precipitate removed by careful filtration. Ten c.c. of the filtrate are put in a small flask, made to 17 c.c. with distilled water, and to this are added 0.8 Gm. of phenylhydrazin hydrochloride, 2 Gm. sodium acetate, and 1 c.c. of 50 per cent. acetic acid. The flask is then fitted with a funnel condenser and gently boiled on the sand-bath for ten minutes, at the expiration of which time it is filtered hot through a filter paper moistened with hot water. The filtrate if necessary is made up to 15 c.c. with hot distilled water, and the whole well stirred with a glass rod.

"In well-marked cases of pancreatic inflammation a light-yellow, flocculent precipitate should appear in a few hours, but in less characteristic cases it may be necessary to leave the preparation over night before a deposit occurs. Under the microscope the precipitate is seen to consist of long, light-yellow, flexible, hair-like crystals arranged in delicate sheaves, which, when irrigated with 33 per cent.

sulphuric acid, melt away and disappear in ten to fifteen seconds after the acid first touches them. The preparation must always be examined microscopically, as a small deposit may be easily overlooked with the naked eye, and it is also difficult to determine the exact nature of a slight precipitate by macroscopic investigation alone."

Far more reliable are the copper and the casein tests:—

Copper Test.—The simplicity, rapidity, and convenience of the copper test for pancreas functioning recommends it as stated by Ehrmann. It is based on the fact that a neutral fat, free from fat acids, is not split by anything but the fat-splitting ferment from the pancreas. Consequently, by addition of a stain which acts only on the fat acids, as they are split by the ferment, the presence of the latter is rendered evident. Commercial palmitin has proved the most suitable neutral fat for the test. The patient takes a test-breakfast of 30 Gm. of ordinary rice starch dissolved and warmed in a glass of water; a trace of salt is added and then 75 Gm. of palmitin, liquefied by heat, is stirred into it and the whole drunk from a glass. After two or two and a half hours the contents of the stomach are siphoned out and some is mixed in a test-tube with equal parts of a mixture of 90 parts petroleum benzin and benzol to 100 parts (Solution I). After the test-tube has been well shaken, the supernatant ether layer is decanted into a second test-tube and there mixed with an equal part of a 3 per cent. solution of copper acetate in distilled water (Solution II). The ethereal layer then assumes a bright-green tint in proportion to the content in fat acids. If none has been split off from the palmitin, owing to the absence of pancreas ferment, there is no color change in the fluid. The intensity of the change in tint is the index of the pancreatic ferment.

Casein Test.—Of all the diagnostic measures at our disposal according to Werzberg, the casein test for the presence of trypsin is the most reliable index of pancreas functioning. If casein is not digested by an extract of the stools, this testifies to lack of trypsin in the stool and

hence to insufficiency on the part of the pancreas.

Werzberg dissolves 0.2 Gm. of sodium bicarbonate in 200 c.c. of distilled water, heats to 50° or 60° C. and next stirs in 0.2 Gm. casein, boils the mixture for one minute, and then filters. He pours 10 c.c. of this casein solution into each of five test-tubes and adds to each in turn 1 c.c., 0.8 c.c., 0.5 c.c., 0.3 c.c., and 0.1 c.c. of an extract of the stool obtained with a 1:1000 soda solution in a proportion of 1 to 10, filtering repeatedly until the extract is limpid. After the stool extract has been added to the casein solution in the test-tubes, he adds 0.5 c.c. of chloroform, and when all has been well stirred he incubates the set of glasses at 37° C. On addition of 0.3 c.c. of a 1 per cent. solution of acetic acid to each tube, the fluid remains limpid if the casein has been digested by the trypsin in the stool, while with lacking trypsin the undigested casein renders the fluid turbid.

Determination of the activity of pancreatic amylase with the duodenal tube is adequate as a test of pancreatic function, proteolytic and lipolytic activities proving practically parallel to the amylase clinically. In performing the author's test, a duodenal tube is passed on an empty stomach, at least 4 inches beyond the pylorus, and 100 c.c. of 5 per cent. Witte peptone solution injected. After 5 minutes, the duodenal return is aspirated by a suction bulb through a 200 c.c. bottle.

In a few moments the "A fraction," consisting mostly of pancreatic juice and containing little bile, begins to flow, and is collected up to about 20 c.c.

Ten test-tubes $\frac{1}{2}$ inch in diameter are placed in a rack and in each are placed definite amounts of duodenal return, water, and reagent, as shown in the following table (beginning with Tube 10):

The reagent, to be freshly prepared, consists of 15 parts of distilled water to 1 part of corn starch solution, the latter made by mixing thoroughly 2 Gm. of the starch with 100 c.c. of distilled water, heating to a boil with constant stirring, and then cooling. When set up, shaken and ready, the rack is put in an incubator at 38° C. or a water bath for 30 minutes. Next, it is taken out, each tube shaken, and 1 drop of twenty-fifth normal iodine solution added to each tube, beginning with Tube 1. Twenty minutes being then allowed for the color changes to become settled, the reading is made by noting which tube has a colorless content, those on the right of it being green to greenish and those to the left, pinkish or grayish to reddish purple. The extreme normal range is between Tubes 4 and 7 (8 to 14 author's units of pancreatic enzyme efficiency). Six units is suspiciously low, meaning a slight hypopancræorrhæa. Lower readings, down to zero, are seen in carcinoma or marked fibrosis of the pancreas, and in acute and suppurative pancreatitis. A. Bassler (Arch. of Int. Med., Feb., 1925).

ETIOLOGY AND PATHOLOGY.

—Chronic pancreatitis usually occurs between the fortieth and sixtieth years. Sixty per cent. of the cases met with occur in the male sex, owing possibly to the greater proportion of individuals of this sex addicted to alcohol. The condition is comparable in many ways to hepatic cirrhosis or fibrosis. Induration of the *head* of the pancreas is the most noteworthy lesion, although the entire organ is sometimes involved.

The most frequent cause of chronic pancreatitis, according to Opie, is

Number of tube:	10	9	8	7	6	5	4	3	2	1
Duodenal return, c.c.	0.1	0.11	0.125	0.14	0.17	0.20	0.25	0.33	0.5	1.0
Water, c.c.	0.9	0.89	0.875	0.86	0.83	0.80	0.75	0.67	0.5	0.0
Reagent, c.c.	4	4	4	4	4	4	4	4	4	4
Units (author's) per 100 c.c. ..	20	18	16	14	12	10	8	6	4	2

obstruction of the duct of Wirsung, due to pancreatic calculi, to biliary calculi in the terminal part of the common bile-duct, or to carcinoma invading the head or body of the gland. Duct obstruction may be followed by the invasion of bacteria, which take part in the production of the resulting lesion.

Ascending infection of the unobstructed duct of Wirsung may follow an acute lesion of the duodenum or of the bile-passages, and may cause chronic inflammation. In cases which have given a history of long-persistent vomiting, chronic diffuse pancreatitis may be found at autopsy, and is probably the result of an ascending infection of the gland. General or local tuberculosis is occasionally accompanied by chronic diffuse pancreatitis, affecting chiefly the interstitial tissue of the gland. Chronic interstitial pancreatitis is not infrequently dependent upon the same etiological factors, notably alcohol, as produce cirrhosis of the liver, and in about one-fourth of the cases the two lesions are associated. Syphilis and trauma may probably also be factors.

Persistent inflammation of adjoining structures may induce chronic pancreatitis, and it is suspected that in some instances infection reaches the organ through the lymphatics instead of the ducts.

Following duct-obstruction and ascending infection the lesion affects principally the interlobular tissue, only secondarily invading the lobular tissue and sparing the islands of Langerhans. Diabetes results only when the lesion is far advanced. Accompanying the so-called atrophic or Laennec's cirrhosis of the liver, the pancreas is at times the seat of a

diffuse chronic inflammation, characterized by diffuse proliferation of the interacinar tissue, which invades the islands of Langerhans. A similar lesion accompanies hyaline degeneration of the islands of Langerhans and the condition known as hemochromatosis. Interacinar pancreatitis is usually accompanied by diabetes mellitus. When diabetes is absent the lesion is of such slight intensity that the islands of Langerhans are little implicated.

Cases of mild pancreatitis observed in which the diagnosis of aortitis had been made owing to pain and abnormal pulsations in the epigastric region. The ache was generally diffuse or to the right or left of the median line, and was increased by pressure. It increased toward the end of gastric digestion, and there was a sensation of oppression. If acute painful phases occur, they may be mistaken for gall-stone or gastric ulcer attacks. The aorta pulsation can be felt over an area much broader than the aorta. Delbet (*Bull. de l'Acad. de méd.*, May 27, 1924).

TREATMENT.—The medical treatment is chiefly dietetic, the aim being to reduce the quantity of articles of food requiring the pancreatic juice for their conversion. Hence the consumption of **fats** or of **meats**, or both, should be **restricted**. Where steatorrhea is the chief manifestation of pancreatic deficiency, the emulsified fats, as in milk, are to be allowed in preference to non-emulsified fats, unless the latter be emulsified by the addition of desiccated bile, as suggested by Cammidge. Solid fats, especially those with a high melting-point, should be avoided. Where azotorrhea predominates, meat restriction is particularly in order. As substitutes for meats, eggs, oysters,

easily digested fish, cheese, mushrooms, nuts and macaroni, together with the casein of milk, are permissible. In general, the vegetable proteins will be better digested than those of meat.

The food should be eaten slowly and well chewed in order to permit of utmost digestion of the carbohydrates by the ptyalin of the saliva. The meals should preferably be frequent and small in amount.

In the presence of gastric hyp acidity or achylia, **hydrochloric acid** taken well diluted, through a glass tube, during the meals, may assist digestion and stimulate pancreatic secretion.

Minced **animal pancreas** has been used with success; **pancreatin** (*q.v.*) is a more convenient remedy, and may be given in salol-coated tablets twenty minutes after meals. Small doses of **sodium bicarbonate** at the same interval after meals tend to allay the local pain. **Holadin**, a preparation of whole pancreas; **pancrobilin**, or pancreas with bile salts, and **pancreone**, a tannate preparation insoluble in the stomach, are all available means of supplementing the spontaneous pancreatic digestion.

In severe cases of disturbed pancreatic function, with marked derangement of *fat* absorption, little can be done with **pancreatic preparations** even in large doses, although disturbed protein digestion can be considerably relieved. In milder cases, however, they yield excellent results. The fatty stools disappear, the striped muscle fibers in the stools markedly diminish, and the weight and general health improve. Fresh **pig** or **beef pancreas** may be given, either in an emulsion or chopped fine and seasoned; $\frac{1}{4}$ to $\frac{1}{2}$ a pancreas may be used daily. Other preparations of the gland may

be substituted. The **diet** should comprise only easily digested food. Stepp (*Therap. Halbmonatsh.*, Aug. 1, 1920).

The cause of the pancreatic disease should be carefully sought and eliminated insofar as is possible. Focal infections, chronic enterogenous toxemia and alcoholism are among the factors to be inquired into. Biliary tract disease being frequently causative, **non-surgical biliary drainage** is in order, and has proven helpful, where there is a mild or low-grade infection of this tract. Where definite cholecystitis or cholelithiasis exists, **surgical treatment** is generally needful. Indeed, a simple laparotomy has repeatedly been followed by recovery in chronic pancreatitis (Walko).

Aside from cases with cholelithiasis, surgical treatment is advisable where there is jaundice and medical treatment fails, or where the patient suffers repeated attacks of severe epigastric pain. According to W. J. Mayo, **cholecystectomy** is indicated where, in the absence of jaundice and of back pressure in the biliary tract, the gall-bladder shows marked evidence of chronic inflammation.

The pancreas suffers from continued insults from a diseased appendix, gall-bladder, stomach or duodenum. If chronic pancreatitis does not yield promptly to medical treatment, early operation is important. Jaundice is nearly always due to an associated lesion of the bile passages, but may arise from obstruction of the common duct because of enlargement of the part of the pancreas surrounding it. Not rarely the jaundice in cases of enlargement and hardening of the gland is relieved by **drainage of the gall-bladder** or by a **cholecystoduodenostomy**. J. B. Deaver (*Med. Jour. and Rec.*, Feb. 6, 1924).

When deep jaundice is present, **calcium chloride** in 20-grain (1.3 Gm.) doses should be given 3 times daily. Mayo Robson also gives it for 24 or 48 hours before operation and in an enema for 24 hours afterward in 60-grain (4 Gm.) doses thrice daily.

CYSTS OF THE PANCREAS.—

Cysts of the pancreas have been divided by Mayo Robson into: (1) Retention cysts; (2) proliferation cysts, or cystic adenoma or epithelioma; (3) hydatid cysts; (4) congenital cysts; (5) hemorrhagic cysts, and (6) pseudocysts. They most frequently develop from the tail, but vary greatly in situation and size.

SYMPTOMS.—The symptoms are influenced by the location and size of the cyst, but those of acute pancreatitis usually prevail; or there may be at first only disturbances of digestion and epigastric discomfort such as occur in chronic pancreatitis. The attention may be arrested by the discovery of a tumor, which may grow rapidly; in chronic cases it usually develops slowly. It may be subject to rapid enlargement from time to time, possibly on account of hemorrhage. The tumor is usually smooth and rounded, lying chiefly to the left of the middle line of the body.

In most cases the cyst grows in the lesser peritoneal cavity, pushes the stomach to the right, and develops between this organ and the transverse colon; sometimes it develops above the stomach, displacing it downward, or below the colon, or to the left in the splenic or renal region.

The cyst may be only slightly movable and is not affected by respiration. It may transmit the aortic impulse, but it is not expansile. In large cysts

fluctuation can sometimes be elicited. Fluoroscopic study of the gastrointestinal tract with a barium meal or enema may give helpful indications; if these are insufficient, pneumoperitoneum with X-ray examination may be availed of.

The most prominent symptoms in pancreatic cyst are fulness after meals, gastric distress, and vomiting at times. Diagnosis of the condition is not difficult where the cyst has reached a considerable size. There is a tumor, usually in the left hypochondrium, with a smooth, even surface and frequently fluctuation. The principal protrusion seems to lie in the left nipple line beneath the costal margin. The dullness on percussion does not extend to the spleen on the left side, nor to the liver on the right. Changes in the configuration of the tumor are of frequent occurrence, depending upon repletion or emptiness of the stomach. Upon X-ray examination there is a filling defect in the stomach due to pressure from the outside. Either a rapid increase in size of the tumor (within a month or 2) or a very slow, protracted course (several years) is characteristic of a cyst. Prompt operation is indicated. Either **removal** of the cyst or **aspiration and drainage** after suturing the opened cyst to the abdominal wall is ordinarily followed by permanent cure. M. Einhorn (*Amer. Jour. Med. Sci.*, Mar., 1925).

A cyst may grow until it distends the whole abdomen. If it projects into the left lumbar region, it renders it flat to percussion and resistant. By its pressure it may interfere with respiration and disturb digestion. Glycosuria is present in some cases. Azotorrhea and steatorrhea may occur.

Neuralgic pains due to pressure on the neighboring nerves, jaundice from compression of the common bile-duct, pressure stenosis of the pylorus with

a resulting dilatation of the stomach, ascites, or intestinal hemorrhage from pressure on the mesenteric or portal veins, edema of the lower extremities from pressure on the vena cava, hydronephrosis from pressure on the ureters are all to be looked upon as possible complications. The cyst may rupture into the peritoneal cavity, the stomach, or intestine. This is followed by a watery fluid from the intestine and a sudden flattening of the abdomen.

DIAGNOSIS.—The following symptoms are of value in establishing a diagnosis of cysts of the pancreas: gastric symptoms, pain, tenderness, vomiting, signs of dilatation, etc.; emaciation; their development in the epigastrium, generally somewhat to the left side; their situation near the posterior abdominal wall, upon the aorta, so that its pulsation is seen and felt; their immobility; the fact that the stomach (dilated) and the transverse colon are found lying upon the cysts.

Pseudopancreatic cysts represent essentially a collection of fluid in the lesser peritoneal cavity and not a true cyst, and only resembles a pancreatic cyst in that the fluid sometimes contains the pancreatic ferments. In 4 traumatic cases each gave a history of severe abdominal pain with nausea and vomiting immediately following the accident. There was some fever, tenderness, and rigidity, which lasted until the tumor was recognized. The tumor can be made out in eight or ten days if carefully searched for and its appearance after an injury, protruding to the left above the umbilicus, together with the other symptoms mentioned rendered the diagnosis of fluid in the lesser peritoneal sac most probable. All the cases were treated by **incision and drainage**. F. A. Besley (Jour. Amer. Med. Assoc., March 28, 1914).

A persistent discharging sinus is in favor of a pancreatic cyst. Hydro-nephrosis, especially of the left kidney, and dropsy of the gall-bladder have to be excluded, as has also a large ovarian cyst. Distention of the lesser peritoneal cavity is often indistinguishable from pancreatic cyst.

As a rule, the content of the cyst consists of serous fluid, does not contain the digestive ferments, and does not reaccumulate after evacuation.

ETIOLOGY.—Pancreatic cysts occur equally in both sexes and usually in adult life, but are met with occasionally in young children. The largest group of cases results from inflammation of the gland or the duct. The tumor may develop rapidly, or may not appear for some weeks or even a year or two.

A second group of cases follow traumatic injury of the abdomen. Of 33 cases collected by Körte, 30 were in males. Probably many of them were due to accumulation of fluid in the lesser peritoneal cavity or to cystic formation in the vicinity of the gland. Doubtless some of them were due to inflammation of the gland or duct, causing occlusion of the latter and retention of secretion as in the first group. Some of them may have originated from hemorrhage into the pancreas.

In a third group there is no history of injury or of inflammation. These are met with in women especially, and run a very protracted course: some years usually.

Pancreatic cysts generally project forward between the stomach and transverse colon. In some cases, however, they appear above, the stomach pushing it downward, and in rare

cases they develop low down in the abdomen, both stomach and transverse colon lying above the tumor. Cysts are usually in the middle line of the body, but may lie to the left, near the spleen if developed from the tail of the pancreas.

The contents of cysts vary in character. Probably in smaller cysts the fluid is dark brown and contains blood or blood-pigment, fat-granules, degenerated epithelial cells, and, it may be, cholesterin. Large cysts are older and the contents are usually grayish, of alkaline reaction, and from 1010 to 1024 specific gravity. The fluid may not only emulsify fat and convert starch into glucose, but also digest albumin and fibrin. The last only is distinctive of the pancreatic origin of the fluid, as the contents of other cysts may possess diastatic and emulsifying power. It is also important to note that the fluid of pancreatic cysts in time loses digestive power (McPhedran).

TREATMENT.—Excepting in the smaller pancreatic cysts accidentally discovered which call for no treatment, **incision, drainage, or extirpation** should be resorted to. The incision is usually made in the median line of the abdomen, exceptionally over the most prominent part of the tumor. It is well to attach the cyst wall to the abdominal wall or to the parietal peritoneum before incising it. After emptying the cyst and **irrigating its cavity with saline solution**, a large glass drainage-tube should be introduced to the bottom of the cavity and surrounded by sterilized gauze. If the cyst is not extirpated, another tumor may subsequently develop. If drainage is resorted to, a fistula may result, which may give

rise to various complications, but in most cases the fistula will eventually heal.

TUMORS OF THE PANCREAS.

—Tumors of the pancreas are comparatively rare; while sarcoma and adenoma are occasionally met with, cancer is by far the most frequent and important.

Carcinoma.—This is more common in men than in women. The head is the usual seat, rarely the body and tail. The cancer is usually of the scirrhous variety, but cases of soft and of colloid growths are occasionally met with. Wirsung's duct is often obstructed and not infrequently the common bile-duct also, causing intense and persistent jaundice. By the size of the tumor or on account of implication of the wall of the intestine, it may cause obstruction of the duodenum. It occurs most frequently between the ages of 30 and 50, but may be met with at any age, even in infancy. Unlike cancer of the gall-bladder, it rarely occurs with calculi. It is usually primary, but the pancreas may be the seat of secondary metastatic tumors when the disease becomes generalized. Carcinoma of the stomach or duodenum rarely extends to the pancreas. It frequently extends by continuity to neighboring structures, and by metastasis to the adjoining lymph-nodes and to the liver.

SYMPTOMS.—These do not differ at first from those of chronic pancreatitis, and are seldom sufficiently distinctive to render a diagnosis possible. There is usually a long history of disturbed digestion. Of the disease itself there may be such suggestive symptoms as deep epigastric pain, which is often paroxysmal,

emaciation, and asthenia. Jaundice, which may develop suddenly or gradually and be intense, with enlargement of the gall-bladder, and ascites from pressure on the portal vein are also noted in most cases. There may be glycosuria, and undigested meat-fibers may appear in the stools as in chronic pancreatitis. As in this disease also, there may be duodenal and pyloric stenosis, with dilatation of the stomach, as a result of pressure. The most important symptom is the presence of a *fixed tumor*, in addition to extreme and persistent jaundice, due to obstruction of Vater's diverticulum, an enlarged gall-bladder, and the gradual emaciation and cachexia.

Though rare, other tumors, such as lymphomata, adenomata, and gummata, are also met with in the pancreas.

DIAGNOSIS.—When the growth is sufficiently advanced the most suggestive signs are the epigastric pain, the immovable tumor, the intense jaundice with the ubiquitous signs of cancer, anemia, emaciation, and cachexia.

Syphilis more often causes diffuse interstitial infiltration. *Miliary tubercle* is not rare. Kudrewetski in 128 cases of tuberculosis found the pancreas tuberculous in 13, or 9.37 per cent. The pancreatic disease seems to be always secondary, either by extension from neighboring organs or hematogenous in miliary tuberculosis.

TREATMENT.—No permanently effective treatment is, in general, available, although complete removal of some tumors of the tail of the pancreas, when unattended with adhesions, is a possibility. In cancer of the pancreas the clinical course averages only two to ten months. Palliative treatment includes a suitable diet

and the administration of **pancreatic preparations**. Restriction of fats will tend to control diarrhea. **Morphine** is used for pain, and the ordinary **analgesics**, local or systemic, for itching. For jaundice and common duct obstruction, **cholecystenterostomy** has been performed with favorable results, and for pyloric or duodenal obstruction, **gastroenterostomy**. **Calcium salts** should be given before operation. The **X-ray** has been used palliatively with asserted benefit.

Three well advanced cases treated with the **X-rays**. In 2 marked improvement followed and the patients seemed well after nearly a year. The exposures were repeated 2 or 3 times at intervals of a month or 2. The third case, with extensive involvement, had a severe hemorrhage 5 weeks after the first treatment and died. G. E. Richards (Amer. Jour. of Roentgenol., Mar., 1922).

When the diagnosis is doubtful, especially in young or middle-aged subjects, **exploratory operation** should be seriously considered, since much may be hoped from surgical treatment in inflammatory conditions (Mayo Robson).

PANCREATIC CALCULI.—**SYMPTOMS.**—Calculi in the pancreatic duct, when small or few, may produce no symptoms and are found unexpectedly at necropsies. When movable, however, they may awaken "pancreatic colic."

The stone in its passage or incarceration may cause symptoms identical with those of gall-stone colic, even to the jaundice, which, however, may be absent in both. Following severe paroxysms of pain in the epigastrium, calculi may be found in the stools, while, sometimes, transient glycosuria follows the attacks of

colic. The pain may radiate toward the first lumbar vertebra, between the shoulders, or to the groins. There may be symptoms of acute or chronic pancreatitis, and cyst of the pancreas may form. There may be much muscle fiber in the stools, which may also be fatty. The patient may lose flesh and strength.

The diagnosis is confirmed when calculi are found in the stools. X-ray diagnosis is a possibility, though rendered difficult by the shadow of the vertebræ.

ETIOLOGY AND PATHOLOGY.

—They are apt to occur between the ages of 35 and 45 years, and are more common in men than in women. They are usually small, like grains of sand, but may be as large as a walnut, and are usually multiple. They are generally round, grayish white in color, and composed chiefly of calcium carbonate with some calcium phosphate. Cholesterin has been found in some cases. They occur in dilated ducts or may be the cause of obstruction and dilatation of the ducts. They may excite chronic interstitial inflammation of the gland or acute suppurative inflammation. These may be followed by marked overgrowth of the fibroid connective tissue and atrophy of the glandular elements. Dilatation or great patency of the ducts or pseudocysts may occur, occasionally with the formation of fistula-like communications with the stomach or intestine. They may cause secondary infection and pancreatic abscess, and have been known to precede cancer of the pancreas.

TREATMENT.—The treatment of pancreatic colic is similar to that for biliary colic—**hot applications** to the

abdomen, **morphine** and **atropine** hypodermically, and **ether or chloroform anesthesia** if the pain is too intense to be controlled by the milder measures.

The interval treatment is that for chronic pancreatitis. **Fluids** in large amount may also be helpful.

Good results have been reported from the hypodermic injection of 1 c.c. (16 minims) of a 1 per cent. solution of **pilocarpine**, three times a week. **Calomel** may be tried.

When the stones are impacted, causing abscess formation or dilatation of the ducts, **surgical measures** are necessary.

Lacouture and Charbonnel found on record 16 cases of pancreatic lithiasis in which operative treatment had been applied, with 3 deaths. In 5 the stone could not be found.

C. E. DE M. SAJOUS,
Philadelphia.

PANCREATIN.—Pancreatin (*pancreatinum*, U. S. P.; extract of pancreas, pancreatic extract) is a mixture of the enzymes existing in the pancreas of warm-blooded animals, obtained from the fresh pancreas of the hog or the ox. Pancreatin occurs as a cream-colored amorphous powder having a peculiar odor and a faint, meat-like taste. It is almost completely soluble in water, insoluble in alcohol, soluble in dilute alcohol, and is precipitated from solution by alcohol in excess. Pancreatin should be absolutely free from all added substances. It is officially required to convert at least 25 times its weight of starch into soluble carbohydrates and 25 times its weight of casein into proteoses. Five ferments are to be found in pancreatin: Trypsin, which converts albumins or proteins (of milk, beef, fish, blood, etc.) into peptone in either neutral, alkaline, or slightly acid media; diastase, or amylopsin, which resembles ptyalin very closely and converts starches into dextrin and sugar;

an emulsive ferment which emulsifies the fats; steapsin, which splits fats into glycerin and fatty acids; and, finally, a milk-curdling ferment.

PHYSIOLOGICAL ACTION AND TESTS FOR PANCREATIN.—The value of a pancreatic preparation depends upon its digestive activity, and upon the quality of the resulting digested product. A pancreatic extract may peptonize milk perfectly, but the peptonized milk may be unfit for food, owing to the development of rancid fatty acids, giving the milk a peculiar, sour, repulsive odor. A good pancreatin should rapidly digest milk, beef, fibrin, and all forms of starchy food. It should convert the casein of milk into peptone without the development of any rancid flavor. The action upon casein may be taken as a satisfactory test of the proteolytic power of any pancreatin. The activity of a pancreatic preparation upon a proteid may be tested as follows: Place into a flask or bottle 15 grains (1 Gm.) of sodium bicarbonate, add 5 grains (0.3 Gm.) of dry pancreatic extract, or pancreatin; mix well and add 1 pint (500 c.c.) of milk warmed to 130° F. (54.4° C.). Shake well and place the bottle conveniently for observation. At first there should be no odor or taste imparted to the milk. In a few minutes the milk will become of a slightly grayish-yellow color which in ten minutes will be more marked, somewhat thinner, and of a distinctly bitter taste, due to the conversion of the casein. This taste is a pure bitter without suggestion of rancidity. For purpose of comparison, a second flask of milk mixed with the soda and water without the pancreatin may be prepared. By withdrawing a small portion of the milk from time to time and adding a few drops of acetic acid, the conversion of the casein may be tested by the character of the curd formed—from the tough casein, to the light, flocculent precipitate, and the final, slight, scarcely perceptible, granular coaguli. The diastasic power of a pancreatic preparation may be tested as follows: Mix 1 dram (4 Gm.) of arrow-root or starch with 5 fluidounces (150 c.c.) of cold water, and boil well. To a fluid-ounce (30 c.c.) of this thick starch (at 110° F.—43.3° C.) add a grain or two (0.06 to 0.13 Gm.) of pancreatin, or dry

pancreatic extract, or a few drops of a fluid product, and stir well. The starch should almost instantly become thin and fluid, like water, showing the formation of soluble starch, which is gradually converted into dextrin and glucose. A product which does not quickly liquefy thick, warm starch-jelly; worthless as a diastasic agent.

THERAPEUTICS.—Pancreatin is extensively used in the preparation of predigested or peptonized foods. It acts best in an alkaline medium, although the use of an alkali is not essential to the action of the pancreatic ferments. To peptonize food is to digest food artificially, to submit it to the action of the digestive ferments, whereby changes are effected precisely similar to those which in the living body are essential before it can be absorbed. Flesh and starch foods are incapable of being absorbed until by the action of the digestive juices they have become soluble. Pepsin is not available for household use in artificially digesting food of any kind. Peptonized food is, therefore, not food prepared with pepsin, or necessarily containing a ferment of any kind; it is digested food. The pancreatic ferments are capable of digesting every known form of food. The peptonizing action is most energetic at about the heat of the body, slow at the temperature of a room (60° to 70° F.—15.5° to 21.1° C.); at a lower temperature, even at freezing, the peptonizing agent is not destroyed, but is simply inactive; at the boiling point (212° F.—100° C.) it is at once destroyed. Peptonized foods are valuable in all cases where the digestive functions are impaired, during the course of **acute fevers**, and in **chronic wasting diseases**. They also fill a useful office during the period of **convalescence from acute and exhausting diseases**. They are therefore valuable in **typhoid fever**, **gastric ulcer**, **acute dysentery**, **chronic diarrhoea**, **gastric catarrh**, **pneumonia**, **tuberculosis**, and **diabetes**. For infants, peptonized milk or milk prepared by Fairchild's peptogenic milk-powder or by means of Fairchild's extractum pancreatis or peptonizing tubes, is a valuable substitute for mothers' milk. When **rectal alimentation** is rendered necessary either from inability to swallow or from inability of the stomach to retain

or digest food, peptonized nutritive enemata become of value. These may consist of milk alone or with egg, or egg-albumin, or of beef peptonized before use.

Pancreatic opotherapy is of diagnostic value in that modification of the quantity of proteins, fats, and carbohydrates in the stools following administration of pancreatin indicates a pancreatic achylia. This **diagnostic test** may be applied in **obstructions of the canal of Wirsung, gall-stones, cancer of the pancreas or cancer of the ampulla of Vater**, and also in certain forms of **acute and chronic pancreatitis**.

Pancreatin, 3 to 10 grains (0.2 to 0.6 Gm.) in capsule, about two hours after meals, and preceded by 10 to 15 grains (0.6 to 1 Gm.) of sodium bicarbonate, will assist **insufficient salivary and intestinal digestion**. It is also beneficial in **nervous and lienteric diarrhea**.

Several cases of **subacute indigestion**, refractory to other treatment, responded magically to pancreas feeding. Benefit was also seen several times in late **pulmonary tuberculosis, carcinoma** (other than gastric), **pernicious anemia**, subacute **septicemia**, **typhoid fever** and marked **debility**. After a sharp attack of **biliary colic** pancreatic function is low and is helped by pancreatic substance and alkalis. Bassler (Med. Jour. and Rec., Jan. 21, 1925).

In **diabetes mellitus** pancreatic therapy has sometimes seemed useful, aside from the obvious benefit from insulin.

In **acute catarrhal benign pancreatitis, in chronic cystic pancreatitis, sclerolymphomatosis, in pancreatic infantilism** and in **pancreatic obesity and emaciation** pancreatic opotherapy is of great value.

In **diphtheria** pancreatin has been used in spray and powder for the purpose of destroying the false membrane and favoring its expulsion. It is usually combined with sodium bicarbonate (3 parts to 1 of soda) for insufflation as a powder; or, 15 grains (1 Gm.) of pancreatin and 5 grains (0.3 Gm.) of sodium bicarbonate, with a dram (4 c.c.) of glycerin in 1 ounce (30 c.c.) of water, may be used as a spray. The latter should be prepared fresh every few hours. Samuel Johnson has suggested

the addition of $\frac{1}{4}$ grain (0.015 Gm.) of corrosive sublimate. Better as a solvent for diphtheritic membrane is the use of **trypsin**. Trypsin may be applied by insufflation, pure or mixed with sodium bicarbonate—4 grains (0.25 Gm.) of trypsin to 1 grain (0.06 Gm.) of soda; it may be applied on a moistened brush or probe covered with absorbent cotton; or mixed with water and sprayed: trypsin, 15 grains (1 Gm.); sodium bicarbonate, 5 grains (0.3 Gm.); water, 1 ounce (30 c.c.); to be prepared fresh every few hours; chloroform or pure creosote, 4 drops, may be added as a preservative.

The proteolytic action of pancreatin has been utilized in the treatment of **urethral and esophageal strictures**, for dissolving **sloughing tissue, coagulated blood, and mucopus**. Pinkuss has used trypsin injections in a case of severe **tuberculous adenitis** of the neck, with markedly favorable results. He injected a **tuberculous tumor** with the same substance and obtained a rapid cure. C. D. Jones has used pancreatin or pancreatic extract for cleaning out **ulcerous cavities** in a case of hip-joint disease. A solution of 1 dram (4 Gm.) to the gill (120 c.c.) of water was poured into an **abscess-cavity** remaining one week after an excision, left in place a half-hour, and the cavity then irrigated. In **hemorrhage of the bladder**, with the formation of clots, pancreatic extract in solution, with or without soda, may be used to dissolve the coagula. W.

PAPAIN, PAPAYOTIN, and PAPOID.—These are preparations of the juice of the fruit of *Carica papaya* (fam., Papayaceæ). The papaw or melon tree is a native of tropical America, where it is cultivated for its edible fruit, which in the green state is used for pickling, and when ripe, as a dessert or hand-fruit and for preserving. The juice is collected from incisions made in the fruit when nearly full-grown. The activity of its enzyme, though inhibited by alcohol, is less easily destroyed by glycerin, salicylic acid, etc., than is pepsin, and these have been used to preserve it. The dried juice is known as *papoid*. A large amount of the inert substance of papaya can be removed by extraction with

water and precipitation of the filtered extract by alcohol; this precipitate contains most of the digestive ferment and is known as *papain*, *papayotin*, or *caricin*, which is an enzyme similar to pepsin, but acting in alkaline, acid, or neutral solutions, occurs as a whitish, slightly hygroscopic powder, soluble in water or glycerin, but insoluble in alcohol, ether, or chloroform. It is given in doses of from 2 to 10 grains (0.12 to 0.6 Gm.), usually in combination with sodium bicarbonate.

THERAPEUTIC USES.—In 5 per cent. solution in equal parts of glycerin and water, it is used as a solvent of **diphtheritic and croupous membranes**. A 16 per cent. solution has been employed in **fissure of the tongue**.

Internally it has had large use in the treatment of **indigestion**, since it transforms proteids into peptones and albumoses by its proteolytic power, and has been found of value in both **gastric and intestinal indigestion**. It is slightly inferior to pepsin in the gastric form, and greatly inferior to pancreatin in intestinal indigestion. W.

PAPAVERINE. See OPIUM AND DERIVATIVES.

PARACENTESIS ABDOMINIS.

—Paracentesis (aspiration) of the heart, pericardium, and thorax is fully described in vols. iii and v. See INDEX. For paracentesis of the tunica vaginalis, see PENIS AND TESTICLES, DISEASES, and HYDROCELE.

Paracentesis of the abdomen consists in puncturing the peritoneal cavity by means of a trocar and cannula, and withdrawing the fluid abnormally present. The operation may be repeated many times and the danger is almost *nil*.

INDICATIONS.—In cases of **ascites** when the presence of fluid may be demonstrated, and the upper pressure against the diaphragm becomes excessive from the distention. Reaccumulation of the fluid after previous operation, giving rise to pressure symptoms, also indicates the procedure.

INSTRUMENTS, etc.—A cannula and trocar (straight or slightly curved), $\frac{1}{8}$ to

$\frac{1}{4}$ inch (3 to 6 mm.) in diameter, or, if preferred, a Dieulafoy or Potain aspirator, a scalpel, a sterile probe, a sterile abdominal binder, a many-tailed bandage or large towel, collodion, cotton, sterile gauze, and rubber adhesive plaster.

SITE OF PUNCTURE.—A location free from vessels and when the abdominal wall is thin is best. The favorite site is in the linea alba, midway between the umbilicus and the symphysis pubis, or at a point in the linea semilunaris, just outside the rectus muscle, on a line midway between the umbilicus and the antero-superior iliac spine. Repeated punctures usually entail a change of site so as to avoid entering the adhesions caused by previous punctures.

THE AMOUNT OF FLUID WITHDRAWN.—There is no harm, usually, in removing all the fluid, if done slowly. The condition of the patient and how he bears the operation will be determining factors.

POSITION OF PATIENT.—When the incision is in the linea alba, the patient should sit upright on the edge of the bed, or lie propped up in a semirecumbent position, in this way causing the fluid to gravitate to the bottom of the peritoneal cavity. The patient should lie on the side to be operated upon when the puncture is made in the linea semilunaris.

PREPARATION FOR OPERATION.—The bowels and bladder should be empty at the time of operation. The abdominal wall should be shaved and surgically disinfected, the trocar and cannula boiled, and the operator's hands thoroughly sterilized.

ANESTHESIA.—Local anesthesia with ethyl chloride, ether, ice and salt, or infiltration anesthesia with a few drops of a 0.2 per cent. cocaine solution is desirable.

TECHNIQUE.—A broad, sterilized abdominal binder, or many-tailed bandage, with a slit corresponding to the site of puncture is, after the site of puncture has been anesthetized, first fitted to the patient's abdomen and, later, tightened at intervals during the operation to give uniform support to the abdominal walls, and to prevent sudden overfilling of the abdominal blood-vessels and syncope. Through the slit in the bandage an incision ($\frac{1}{4}$

inch long) is made in the skin at the chosen site, and the trocar is slowly but firmly inserted, with the index finger at the side of the cannula as a guide to the depth of its entrance, and to guard against its going in too deep. The fluid should be withdrawn slowly and at intervals the finger should be placed over the end of the cannula to stop the flow and allow the abdominal contents to adjust themselves to the changed conditions. Sudden stoppage of the stream through occlusion of the cannula by intestines or omentum requires that the cannula be slightly turned or its position changed, or if necessary a sterile probe may be passed through it. As the fluid is withdrawn the bandage is gradually tightened to prevent syncope. If the latter occurs the end of the cannula should be closed with the finger, to prevent entrance of air, and the patient's head should be lowered.

When the fluid has been withdrawn, remove the cannula quickly, placing the finger-tip over the opening. If the latter is large a subcutaneous suture may be inserted and the skin drawn together. The line of incision, including the puncture, is then sealed with collodion, and a pledget of cotton applied over it. A sterile gauze pad, held in place with rubber adhesive plaster, may be necessary if there is much oozing of fluid. Twenty-four hours' rest in bed should always follow the operation.

W.

PARALDEHYDE.—Paraldehyde (paraldehydum, U. S. P.), $C_6H_{12}O_3$, is a polymeric form of ethyl aldehyde (acetic aldehyde, acetaldehyde). It is made by passing gaseous hydrochloric acid into aldehyde at ordinary temperature. When the liquor is no longer soluble in an equal volume of water, the conversion into paraldehyde is complete. The crude product is cooled to below 0° C. (32° F.), and the crystalline mass is carefully distilled. The process of freezing and distilling are repeated until the whole product volatilizes at 124° C. (255.2° F.). It should be kept in well-stoppered, dark amber-colored bottles, in a cool place.

Paraldehyde is a colorless, transparent liquid. It has a strong, characteristic, but not unpleasant nor pungent odor, and a

burning and cooling taste. It is soluble in alcohol, ether, oils, and chloroform, and in 8 volumes of water at 25° C. (77° F.), the latter solution becoming turbid when boiled. Paraldehyde is neutral, or has a faint acid reaction. The dose is from 30 to 90 minims (2 to 6 Gm.) given with an equal volume of sweet-almond oil in capsules, or well diluted with aromatic elixir, sweetened water, brandy, or rum.

PHYSIOLOGICAL ACTION.—Paraldehyde is a safe, pure hypnotic, resembling chloral in its action on the brain. In moderate doses, a natural sleep is speedily induced, which lasts from five to seven hours, without untoward after-effects (headache, weariness, etc.). The blood-pressure is lowered, but less than by chloral. It has no influence over pain, and for that reason should not be used as an hypnotic when pain is the cause of the insomnia. Continued use may impair digestion, cause diarrhea, and irritate the skin (cutaneous eruptions) and mucous membranes, particularly those of the nose, thorax, and abdomen. Paraldehyde, as shown by Gordon, is mainly eliminated by the lungs, being readily detected in the breath six or eight hours after its ingestion. In the urine it can also be recognized three or four hours after ingestion. The drug markedly increases the elimination of urea and also the watery constituents of the urine.

ACUTE POISONING BY PARALDEHYDE.—Toxic doses cause coma, muscular relaxation, lowered arterial pressure, and death from respiratory failure. In poisonous doses paraldehyde reduces the hemoglobin of the blood to methemoglobin. The clinical picture of poisoning by paraldehyde is characteristic: the patient is found in a deep stupor and limp, like one under the influence of chloroform, with a strong odor of the drug on his breath, face slightly flushed, pupils moderately contracted and quite insensible to light; pulse about 120 and weak; respirations may be as frequent as 40.

Treatment of Acute Poisoning.—The treatment of acute poisoning by paraldehyde is directed against the paralysis of the respiratory center. Respiratory stimulants, atropine, coffee, and electricity are indicated.

CHRONIC POISONING BY PARALDEHYDE.—Several cases of the paraldehyde habit are on record, and the results, both physical and mental, have usually been most wretched. Peterson, however, reported a case in which a woman took 1 ounce (30 Gm.) nightly for months, without ill effects—on the contrary, she became quite fat. Usually the patient becomes rapidly emaciated, has a feeling of great cardiac and general muscular weakness, and frequently suffers delusions of persecution and mental failure.

In a case reported by Hartz the objective symptoms were: restlessness, tremor, cyanotic condition of the hands, congestion of buccal mucosa; dry, coated, and fissured tongue, with fine tremor. There was marked evidence of existing arteriosclerosis. The insomnia was persistent and resistant to powerful hypnotics other than paraldehyde.

Krafft-Ebing, Fornaci, and Quarelli observe that symptoms resembling those of chronic alcoholism generally follow the long-continued use of the drug in large doses, and epileptoid convulsions are not infrequently observed.

THERAPEUTICS.—The chief use of paraldehyde is as an hypnotic and nervous sedative, but is *contraindicated* in cases of cyanosis with depression of the respiratory centers, as in the advanced stages of emphysema with cardiac dilatation. Care should be exercised if used in cases of insomnia attended by much physical or mental depression. Bright's disease, apparently, is not a contraindication to its use. For those who are taking iodides, paraldehyde should not be prescribed.

In the **sleeplessness of chronic alcoholism, chronic mania, and delirium tremens** paraldehyde is a valuable hypnotic.

In **spasmodic asthma, puerperal convulsions** and **irritative cough**, the drug is useful in small doses (30 minims—2 Gm.) repeated every half-hour for from 1 to 3 doses.

In **Cheyne-Stokes respiration** associated with **bronchopneumonia**, paraldehyde is very useful. Cevello found that 30 to 45 drops of paraldehyde at night, combined with the use of caffeine (4 to 8 grains—0.25 to 0.50 Gm. in divided doses during the day), by increasing the urinary secre-

tion, in cases of **edema, ascites, and pleuritic effusion**, was of material benefit.

Paraldehyde has been suggested as an antidote in strychnine poisoning.

INTRAVENOUS PARALDEHYDE ANESTHESIA.—Highly favorable results have been obtained from the use of paraldehyde administered intravenously as an hypnotic or **anesthetic for minor operations**. The hypnotic effect is induced very rapidly and is free from untoward effects, except a momentary depressant effect which may be avoided by combining with it an equal quantity of ether. From 5 to 15 c.c. of paraldehyde with an equal quantity of ether are mixed and dissolved in 150 c.c. of a cold 1 per cent. sterile saline solution. This is placed in a sterile bottle with a rubber cork through which pass two glass tubes, one reaching to the bottom of the solution and with a rubber tube armed at the distal end with a fine hypodermic needle for puncture of the vein; the other tube, ending above the surface of the solution, has a rubber bulb and tubing attached. The solution should be perfectly clear after shaking, and may be used cold or not exceeding 25° C. (77° F.). After filling the first tube, tubing, and needle to exclude all air, the needle is introduced within the median basilic vein. By pressure on the bulb the solution is very slowly introduced into the vein at the rate of 5 to 10 c.c. per minute. In five seconds the patient tastes paraldehyde; in ten seconds it can be detected in the breath; in twenty seconds a sensation of general warmth with dizziness or a sense of floating is felt; in thirty seconds consciousness begins to disappear; in forty seconds unconsciousness is complete; in sixty seconds there is profound unconsciousness; in ninety seconds corneal reflex is absent and anesthesia is complete. As elimination is very rapid through the lungs, the entire amount of the solution will be required for a prolonged effect. Consciousness is restored in twenty minutes after stopping the infusion, and no untoward after-effects have been observed.

If preferred, the solution may be introduced by gravity. Grave cardiac or pulmonary disease is said not to contraindicate the use of this method, which has

been used with perfect success in these cases for its hypnotic action. Alcoholics, acute and chronic, come under its influence more rapidly.

W.

PARALYSIS AGITANS. See TREMOR.

PARASITES, DISEASES DUE TO.—INTESTINAL PARASITES.

—Parasites which infest the human intestinal tract may be divided into (1) nematodes, or round-worms; (2) trematodes, or sucking-worms; and (3) cestodes, or tape-worms.

NEMATODES (Round-worms).—

All round-worms occurring as parasites in man belong to the order of Nematodes. They have long, slender bodies of simple outline, without segments or appendages. They are usually bisexual and provided with alimentary organs. The males are usually smaller than the females. Some nematodes as found in the human intestines are quite harmless, but others are more dangerous; a few pass into more sensitive tissues and organs, producing disturbance or even dangerous injuries.

Ascaris lumbricoides, the common round-worm, is in color a yellowish or reddish brown, cylindrical in shape, and tapering at the ends, marked with fine transverse striæ, and characterized by four longitudinal ridges running their entire length, somewhat similar in appearance and shape to the earth-worm. The female is from 20 to 40 cm. in length; the male is smaller, about 20 cm. in length and provided on its posterior extremity with a bend like a hook, carrying two projections or processes. The cephalic extremity of both male and female has three oval papillæ furnished with fine teeth. The sexual

organs occupy the posterior half of the body, the sexual opening being at the junction of its anterior and middle thirds. The female produces an enormous number of eggs, which, when fully developed, possess a double shell, around which is an albuminous envelope. They are about 0.05 to 0.06 mm. long, elliptic and dark reddish in color. These are found almost anywhere in the intestinal canal, but chiefly in the small intestine, and are very resistant to external influences. These ova mature and develop into the round-worm in the intestine, requiring no intermediate host. They attain sexual maturity in from ten to twelve weeks after the eggs have been swallowed, at which time the length of the female is 20 to 30 cm. and that of the male 13 to 15 cm. Infection occurs through the ingestion of ova in food or drinking-water. Usually not more than one or two are present, but they may occur in enormous numbers.

Symptoms.—The presence of the round-worm only rarely produces any symptoms in its host; even then they are often most obscure. In children, however, it sometimes causes a variety of forms of intestinal irritation, which tends to precipitate nervous disturbances. Peiper and others suggest that these nervous symptoms are caused by an irritating toxin, derived from the round-worm. Chauffard, Marie, and Tauchon describe a condition called *typholumbricosis* as due to this substance. This is a complex of fever, colicky pain, nausea, vomiting, indigestion, restlessness, irritability, anorexia, itching of and picking at the nose, disturbed sleep with grinding of the teeth, salivation, nervous twitchings, foul breath, and inter-

mittent diarrhea, which continues for a month or more (Osler), and sometimes is accompanied by prolonged coma (Voucka) or follicular enteritis (Concetti). These parasites often induce the basis of neurasthenic, hysteroid, epileptiform, and choreiform disorders (Thermais).

There can be no doubt concerning the importance of an examination of the feces for ova in all obscure cases presenting reflex neuroses, as very nervous children may show convulsions, choreic movements, dilated pupils, vertigo, cephalalgia, mental disturbances, and even contractures.

Fever may result from toxins secreted by the parasite, and anemia may be marked. Couillaud has described a "tongue sign" of ascaris or oxyuris infestation, consisting of hypertrophy of the fungiform papillæ and scattered red dots along the base, sides and tip of the tongue.

The round-worm occasionally finds its way into the normal or abnormal openings in the surface of the intestinal canal, and thus produces mechanical disturbances. They are sometimes found in the feces, and are occasionally ejected from the mouth while vomiting. They have also been known to obstruct the common gall-duct, enter the larynx and Eustachian tube, causing asphyxia, pulmonary gangrene, perforation of the membrana tympani, hepatic abscess, or other more or less grave disturbances.

Ascaris infestation may be readily demonstrable with the X-rays. In a case with obscure abdominal symptoms, a worm-like filling defect in 2 loops of the jejunum was observed. Later, as the barium-meal moved down, curved filling defects were seen in successive portions of the jejunum and ileum. **Santonin** and **oil of**

chenopodium were followed by the passage of ascaris ova and 2 worms. H. R. Schinz (Deut. Zeit. f. Chir., Mar., 1924).

Complications.—Jaundice may develop, due to obstruction of the bile-ducts. Intestinal obstruction may occur if the worms are numerous. Perineal abscesses and inflamed herniæ that have perforated externally sometimes discharge the *Ascaris lumbricoides*. Appendicitis may be induced by this parasite.

Treatment.—Before giving any anthelmintic the intestine should be free of food for twenty-four to thirty-six hours so that the drug may act directly on the unprotected worm.

For the removal of the lumbricoid worms nothing has been found to equal **santonin**, which, if judiciously used, is almost always satisfactory. It must be borne in mind that very considerable ill-effects have followed the excessive or prolonged use of this drug—not only xanthopsia, but hebetude or torpor, and in some instances death.

The dose of santonin should not be above $\frac{1}{6}$ to $\frac{1}{2}$ grain (0.01 to 0.03 Gm.) if frequently repeated, or 1 to $1\frac{1}{2}$ grains (0.06 to 0.1 Gm.) a day in children of 1 to 6 years (Demmi).

An adult may be given 2 to 4 grains (0.13 to 0.26 Gm.) of santonin in a troche before breakfast for two or three days, followed by a brisk purge, preferably calomel, or the **santonin** and **calomel** may be given in combination. A good rule is to give to a child of from 2 to 4 years from $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.016 to 0.03 Gm.) of santonin along with the same amount of calomel, and after a very light supper composed of $\frac{1}{2}$ glass of milk, each night, for three successive nights.

The writer has met 11 cases in which an **operation** was required for evil done by ascarides. In 6 cases these were in the open abdominal cavity; in 3 there was ileus from obstruction by them; they had perforated the intestine in one case, and in another they had caused adhesions and volvulus. In one case as the abdomen was opened the appendix was suddenly stretched out to nearly twice its length by an ascaris within. It is safer to make no attempt to remove the helminths at the laparotomy. Repugnant as it is to leave them alive, the successful outcome in the writer's cases confirms the wisdom of doing so and trusting to santonin to expel them later; 117 were thus voided in one of his cases and 489 in another. Schloessmann (Beiträge z. klin. Chir., xc, No. 3, 1914).

Naphthalin is recommended by Engel: from $\frac{1}{3}$ to $1\frac{1}{2}$ grains. (0.02 to 0.1 Gm.), four times a day, for three days. **Oil of chenopodium** in doses of from 5 to 10 drops in emulsion, capsules, or on sugar is also useful. Some use the unofficial **fluid-extract of spigelia and senna** in from 1- to 3- dram (4 to 12 c.c.) doses.

The writer prefers the official **oleum chenopodii** to the less reliable santonin. In proper doses, the oil will act with certainty and toxic symptoms do not occur. The urine turns a distinct yellow which changes to red after the addition of soda lye. Occasionally there is slight headache with nausea, but never any albumin or sugar in the urine. The writer recommends the following prescriptions:—

℞ *Ol. chenopodii*

anthelmintici .. ℥xvj (1 c.c.).

Mentholis gr. iij (0.2 Gm.).

M. dent. tal. dos. vi ad caps. gelat.

Sig.: Every two hours one capsule for 3 doses on two successive days, during the morning in hot coffee and milk.

℞ *Ol. ricini* ℥iii½ (70 Gm.).

Sig.: Two tablespoonfuls two hours after the third capsule on each day.

The menthol acts as corrective and prevents nausea. For oxyuris, the oil has not proven so satisfactory. M. Glockel (Münch. med. Woch., Aug. 2, 1910).

Where santonin is not well borne or ineffective, and in older children, a combination of **oil of chenopodium and menthol** is useful:—

℞ *Olei chenopodii* .. ℥x (0.6 Gm.).

Mentholis gr. iss (0.1 Gm.).

M. Divide in capsulas no. vi.

The doses given are suitable for a child 10 years old. Three capsules should be administered at intervals of two hours on two successive days, and $\frac{1}{2}$ ounce (15 c.c.) of **castor oil** given in addition on the second day. Railliet (Bull. méd., April 17, 1912).

OXYURIS VERMICULARIS

(*Ascaris vermicularis*), the seat-worm, thread-worm, pin-worm, also called the awl-tail, maw-worm, maggot, is a small, whitish round-worm which in man sometimes infests the large intestine and the lower part of the small intestine. They may frequently be found as high as the cecum and have even been seen in the stomach and mouth. The length of the female is 10 mm. and pointed at the caudal end like an awl; the male is 4 mm. in length with a blunt posterior extremity provided with a spiculum. Leucart claims they are incapable of multiplying *in situ*; for development the ova must be swallowed. The eggs are brought forth by the female in enormous numbers, and are only developed in the intestinal tract of man or beast. They are about 0.05 mm. in length and develop into oxyures in about two weeks after they are ingested. These eggs are very

vigorous and offer marked resistance to external agencies.

The favorite habitat of these worms is the rectum, where the female lays immense numbers of eggs that mature and are discharged with the feces. The worms frequently crawl out of the anus and in females may enter the vagina and cause vulvovaginitis, pruritus, and leucorrhea. Infection with the ova may take place through food and water or from the hands of infected persons.

Symptoms.—The symptoms of the thread-worms are itching of the anus, usually worse at night, accompanied by disturbed sleep and extreme irritability; burning pain, tenesmus, frequent micturition, restlessness, anorexia, and anemia are frequent symptoms. Chorea and convulsions may be occasionally caused. The irritation resulting from the presence of the parasite may also be the cause of masturbation in both sexes, and prolapsus ani.

Diagnosis.—The diagnosis is easily made by exploring the rectum and finding the oxyures or by examination of the feces for the worms or their ova aided by the microscope.

Treatment.—In the treatment of thread-worms (*Oxyuris vermicularis*) very little has been offered in recent literature that bears the stamp of novelty. Scrupulous **cleanliness** is the first essential. The parts about the anus, especially after each stool, should be bathed with a 1:10,000 **bichloride of mercury** solution. The most important points are the mechanical and chemical cleansing of the lower bowel and the use of such drugs by the mouth as are known to paralyze or destroy the worms. The indications are summed up by San-

som: first, to expel the intruders and all their ova by the use of simple **aperients**, kept up for several weeks, along with **enteroclysis of pure water**, which causes the parasites to swell up and burst; second, to prevent the entrance of ova into the digestive tract by the use only of **food and drink** which have been **thoroughly cooked**.

Preventive measures, among infected children, are of great importance (Nicholson), such as keeping the **nails short and clean**, **dipping them** frequently into **quassia**, and enforcing **isolation** until a cure is effected. For the intestinal irrigation plain water suffices, if used repeatedly and for a long-enough period, which is daily for a week or two or twice a week for five or six weeks. Holt regarded injections of **bichloride of mercury** as the most efficient. The colon should be first thoroughly cleansed by a solution of lukewarm water containing 1 dram (4 Gm.) of **borax** to the pint (500 c.c.). After this is discharged half a pint of a 1:10,000 solution of bichloride of mercury should be injected into the bowel high up through a catheter and retained as long as possible. The **infusion of quassia** (1 to 2 ounces—30 to 60 Gm.—of the powder or chips to a pint—500 c.c.—of water) enjoys an especial reputation in this connection, and is the remedy which we have mostly used, from three to five irrigations, on consecutive days, usually sufficing; in obstinate cases, where the infection reaches very high up, more may be required. **Carbolic acid**, **turpentine**, **tannin**, **vinegar**, **camphor**, **potassium sulphide** and **oil of eucalyptus** may also be employed in rectal irrigations.

Solutions of Castile soap are recommended by Monti, continued for from one to three weeks. A. Gremand regards **sulphur water** as the most satisfactory, *per clyisma* as well as *per os*. W. N. King recommends a saturated aqueous solution of **socotrine aloe**, 1 ounce (30 c.c.) of which is injected into the bowel at bedtime and retained; this should be repeated for several consecutive nights.

In addition to the removal of the adult female worms from the lower bowel with enemas, it is necessary, for curative results, to expel the young parasites from the small intestine. For this purpose, **thymol** may be given in a dose of $7\frac{1}{2}$ grains (0.5 Gm.) for a child below 5 years, up to 1 dram (4 Gm.) for an adult (Ashford and King). **Santonin** and **calomel** may also be used, or **oil of chenopodium**—the latter preferably preceded and followed by **castor oil**. S. Martin has recommended a **mixture of rhubarb, magnesium carbonate and ginger in small doses**. Ashford recommends **betanaphthol** in 2-dram (8 Gm.) doses. The larval forms may be destroyed by the administration daily for five days of **methylene blue** in doses of 18 to 24 grains (1.2 to 1.5 Gm.) per day. This treatment is given three times, ten days apart. **Saline cathartics** and simple bitters, especially **quassia** and **gentian**, may be tried instead. Addition of **garlic** to the food enjoys a very ancient reputation.

One of the difficulties met in the removal of threadworms is that the worms cause itching at the anus, so that the ova get under the finger nails, and next morning, into the food, thus renewing the infection. The remedy is to wear **tight drawers** at night, to prevent direct scratching,

and **cutting the finger nails short**. Brumpt (Bull. méd., Nov. 26, 1921).

Enemas give only temporary results. The course of the disorder shows cycles of 6 or 7 weeks, doubtless due to new generations of parasites. The object in treatment should be to destroy the young worms before they are able to reproduce. The vermifuge treatment is made more effective by the ingestion of 15 to 20 Gm. (4 to 5 drams) a day of fresh scraped **raw onions** or **garlic** for 6 or 7 days previously. **Santonin** combined with **naphthalin** and **phenol** then proves especially effective. Complete cure is not certain until 2 months have elapsed without the appearance of worms or ova in the stools. Heubner (Jahrb. f. Kinderh., Apr., 1922).

Eleven patients treated, with good results in all known instances, as follows: Older children and adults were told to eat 0.5 liter (1 pint) of **fresh blueberries** 3 or 4 times on the first day, and for the next 6 days, once daily. Nyberg (Finska lak. handl., May-June, 1923).

For the relief of the anal pruritus **mercurial ointment** is useful; it serves the double purpose of soothing the parts and preventing the escape of the worms from the bowel. **Injections of laudanum and starch-water** (3 to 5 drops to the ounce—30 c.c.), **carbolyzed vaseline**, and **belladonna ointment** are useful in allaying rectal irritation.

Having recommended **bismuth carbonate** to 2 patients with gastric and duodenal ulcer, and obtained unexpected effects in completely freeing them of pinworms which had resisted all previous measures, the writer used it regularly in treatment of oxyuriasis, giving adults on 2 successive days, 10 Gm. ($2\frac{1}{2}$ drams); children of 7, 4 Gm. (1 dram), and under this age, only 2 or 3 Gm. (30 or 45 grains). The drug proved effective even in families where parents

and children were all affected. In 4 or 5 days the parasites and ova disappear from the stools, or a second or third course may be required. Loeper (Prog. méd., July 31, 1920).

Loeper's method of using **bismuth carbonate** in expelling oxyurids used by the writer in a rebellious case in a woman of 22. After a week of strict **milk diet**, 5 Gm. (1¼ drams) of **bismuth carbonate** were taken morning and evening in a glass of water for 3 days. This was followed by a **purge** and **local mercurial salve**. The course was repeated a month later without dieting, but followed by a **calomel purge**, and the patient has been permanently relieved. Barrio (Arch. Españ. de Pediat., Jan., 1921).

ASCARIS ALATA (*Belascaris mystar*) is a nematode sometimes found in the intestines of the dog and cat and occasionally in man. The female is about 6 to 7 cm. and the male about 4 cm. long. The head has a wing-like projection on either side, the body is slender, and the tail is closely rolled in a spiral.

TRICHOCEPHALUS DISPAR (*Ascaris trichiura*), or whip-worm, is a generally harmless, but quite common, intestinal parasite, frequently found in the cecum, and occasionally in the colon.

The size of male and female are similar: from 4 to 5 cm. in length. The forepart of the body is narrow and the afterpart much thicker, giving it the appearance of a whip. The sexual organs are in the thicker portion, and in the posterior end is a spiculum. In the male this end is spirally coiled. The eggs are elongated and oval in shape, have a peculiar button-like protuberance at each end, resemble diminutive lemons, and are 0.55 mm. long; they possess a thick, brown shell, at each pole of which is

a clear, globular mass. They develop slowly and first in water and damp earth, and are very resistant to cold and dryness. The **trichocephalus** occurs in Europeans more frequently than in Americans. It is found also in the domestic animals.

It rarely, if ever, produces any symptoms, even when occurring in enormous numbers, though some claim it sucks blood and causes anemia.

TRICHINA SPIRALIS, an intestinal parasite of the rat, dog, cat, hog, and man, occurs in two forms: the trichina of the intestines and the trichina of the muscles—phases of their development. Sexual maturity is reached in the intestines, where it appears as a small, white, hair-like worm, the female 3 mm. in length, the male much smaller, 0.8 to 1.5 mm., readily visible to the naked eye. In shape it is long and narrow, the intestinal canal beginning with a muscular mouth acting as an intestine. The organ increases in caliber, passes down into the food-canal, and is surrounded throughout its length by a row of large cell-bodies. The eggs develop into embryos within the uterus and are set free at birth.

The embryo, or muscle trichina, which is from 0.6 to 1 mm. in length, lies coiled up in an ovoid capsule, which is at first translucent, but later becomes opaque and infiltrated with lime-salts.

When trichinous flesh is eaten by man or by certain animals the capsules are digested in the stomach and the trichinæ liberated. Passing into the small intestine they become sexually mature in from two to four days, when they produce innumerable embryos. The intestinal trichinæ

usually die in four to five weeks, after the females have produced several broods of embryos. These embryos leave the intestines for the muscles, the mode of transmission being, according to J. Y. Graham, through the blood-stream. About two weeks after reaching the muscle they attain the larval form. The irritation caused by their presence results in an interstitial myositis and the formation of a fibrous capsule. As a rule, the capsule is occupied by only one worm, but occasionally two or three are seen together. The trichinæ may thus live for years in the muscles. According to Osler, the dissecting-room and post-mortem statistics show that from $\frac{1}{2}$ to 2 per cent. of all bodies contain trichinæ. Of 1000 consecutive autopsies of which he had notes, trichinæ were present in 6 instances. About 900 cases have been reported in the United States in the past forty-five years (Beecher). It is more frequent in European countries. The eating of improperly cooked pork furnishes the greatest cause of this disease in man. Recent investigations show the fatty as well as the muscular parts of pork may contain live trichinæ. Solmon's report shows that about 2 per cent. of American hogs are infected.

Symptoms.—If only a small number of trichinæ are swallowed, no symptoms follow; but, in case of a large dose, gastrointestinal symptoms—consisting of loss of appetite, vomiting, pains in the abdomen, and diarrhea—develop within a few days. The diarrhea may resemble that of cholera, or there may be obstinate constipation. Bodily fatigue and muscular weariness are present before the evidence of myositis. When

the embryos begin to invade the muscles, which occurs between the seventh and fourteenth days, there are usually chills and fever. Myositis is present and is characterized by stiffness, tension, and pain on pressure and movement. The flexors of the extremities are particularly sore and contracted, sometimes causing acute flexion of the elbows and knees. There may be difficulty in mastication, phonation, and deglutition, and an intense and distressing dyspnea may add to the suffering. The temperature shows remissions usually and may be subnormal. The pulse corresponds to the temperature. Edema, seen early in the face, is noted in almost all the cases, and may be intermittent. Ascites may occur. Laryngeal edema and bronchial catarrh often increase the dyspnea. Pleurisy or pneumonia may be present. Profuse sweating, miliaria, itching and tingling of the skin, acne, urticaria, furunculosis, and herpes may occur. In protracted cases, especially, anemia and emaciation are often great. Such nervous symptoms as dilatation of the pupils, insomnia, loss of tendon-reflexes and headache have been noted. The blood shows a marked leucocytosis, which may reach above 30,000, and may prove of value in forming a diagnosis. Eosinophilia, sometimes amounting to as high as 68 per cent., is usually noted but may be absent in very severe cases. Albumin and casts may be found in the urine.

Pathology.—The diaphragm is most thickly infested with the larval trichinæ. Next in order are the intercostals, abdominal muscles, muscles of the neck, larynx, head, eyes, and extremities. Microscopically the mus-

cles show the changes of acute myositis. The trichinous cysts in the muscles macroscopically appear as small, grayish-white, opaque, oat-shaped specks, longitudinally arranged in the muscle fibers.

Diagnosis.—In addition to the above-mentioned symptoms, the stools may afford important information. They should be examined with a low-power lens, under which the trichinæ appear as small, silvery threads. The diagnosis, when doubtful, may be confirmed by obtaining a piece of muscle from the biceps by a small instrument called a harpoon.

Acute rheumatism sometimes resembles this disease, but the joint swelling in the one and the great increase in the eosinophiles in the other will aid in separating them. *Cholera*, *acute polymyositis*, and *typhoid fever* may also simulate trichiniasis, and must be carefully differentiated.

Prognosis.—The prognosis should be guarded, since it greatly depends upon the number of trichinæ swallowed, and upon the number of embryos generated in the intestines. A favorable symptom is early diarrhea.

Treatment.—As a *prophylactic* measure, **care** should be taken with regard to the **feeding of hogs** to prevent this infection, the **destruction of rats** about styes, and **rigid inspection of the meat-supply**. **Thorough cooking** should always be insisted upon when pork is utilized as an article of diet.

As soon as it has been discovered that trichinous meat has been eaten, some purgative, of which **calomel** followed by a **saline** is the most useful, should be given. **Senna**, **aloin**, **rhubarb**, or **glycerin** may be tried. Some

anthelmintic, such as **male fern**, **santonin**, or **thymol**, should be used in conjunction with the purgative. **Turpentine** may be used in full doses. For the muscular pains, **hot baths** and **anodyne applications** sometimes afford relief, while the **bromides** may secure the much-needed sleep. The patient's strength is to be maintained by easily assimilable, **nutritious food**, and stimulants, such as **strychnine**. In convalescence **massage**, **electricity**, and **local applications** will help remove soreness and stiffness. The disease lasts from about 2 weeks to 4 months.

It may be possible early to abort the disease by **gastric lavage**, a **cathartic**, and **thymol**, 2 grains 4 or 5 times in the first 24 hours, followed by a cathartic. Booth injects 2 to 3 c.c. of a solution of 1 grain of thymol per c.c. of sterile olive oil, every day for 7 days. G. Merkel favors **glycerin**, 1 tablespoonful every hour, with **laxatives**. M. E. Alexander (Amer. Jour. Med. Sci., Apr., 1923).

THE HOOK-WORM.—Ankylostoma or Agchylostoma.

The hook-worm belongs to the class of Nematodes; family, Strongylidæ. It is a common parasite of the intestines, where it causes a disease variously called: hook-worm disease, ankylostomiasis, uncinariasis, dochmiosis, Egyptian or tropical chlorosis, tunnelworkers' disease, brickmakers' disease, miners' anemia, mountain cachexia, ankylostomanemia, mal de cour, negro consumption, tun-tun, and many other names.

Historical Sketch.—Cases of this disease were described as early as 1648, but the cause was unknown. The first hook-worms were discovered in 1782 and 1789. In 1838 Dubini described the worm, gave to

it the name of *agchylostoma*, and attributed to it certain pathological lesions, but no special disease. Griesinger in 1854 emphasized the relation of this parasite to "Egyptian chlorosis." Similar reports were made later by Brazilian and Italian physicians, who proved it to be the cause of brickmakers', miners', and tunnelworkers' anemia.

Grassi and Parona established the diagnostic test of finding the ova in the feces in 1877.

It was soon found that hook-worm disease existed in nearly all European countries. Joseph Pitt (1808) is probably the earliest author to refer to the disease in this country, though he was ignorant of the cause and believed it to be due to the habit of negroes eating dirt, and this was the belief of other physicians of his and later times. In 1901 Dr. Allen J. Smith found hook-worm ova in the feces of a plantation overseer in Texas, and discovered that the worms expelled from the patient were different from the European hook-worm. In 1902 Stiles described the new species, gave it the name of *Uncinaria americana* or *Necator americanus*, and declared the existence of an endemic of hook-worm in the United States. Looss in 1898, at Cairo, Egypt, discovered that infection occurred by the larvæ penetrating the skin.

Geographical Distribution.—"Hook-worm disease belts the earth in a zone about 66 degrees wide, extending from parallel 36 degrees north to parallel 30 degrees south." (Publication No. 61—"The Rockefeller Sanitary Commission for the Eradication of Hook-worm Disease.") The following is a list of the reported infected countries:—

AFRICA.—Algeria, British East Africa, Zanzibar, Egypt, Gold Coast Colony, Lagos, Natal, Sierra Leone, Tunis.

SOUTH AMERICA.—Antigua, Argentina, Barbados, Brazil, British Guiana, British Honduras, Colombia, the Dominican Republic, Ecuador, French Guiana, Guatemala, Jamaica, Honduras, Martinique, Nicaragua, Panama, Paraguay, Peru, Porto Rico, Salvador, Dutch Guiana, Trinidad, Venezuela.

NORTH AMERICA.—The United States from Virginia to Florida and Texas; Mexico.

ASIA.—Bagdad, Ceylon, China, India, Japan, Java, Korea, Malay States, Philippine Islands, Samoa, Straits Settlements, Sumatra, Australia.

EUROPE.—Austria, Belgium, Bulgaria, France, Germany, Italy, Netherlands, Spain, Switzerland, Wales.

Climate.—The worms are most prevalent where the temperature ranges between 78° and 95° F. (25.5° and 35° C.), and a moist, sandy soil makes the best incubator.

ANKYLOSTOMA DUODENALE (Dubini, 1838).—**Synonyms.**—*Strongylus quadridentatus* (von Siebold, 1851); *Dochmius anchylostomum* (Molin, 1860); *Sclerostoma duodenale* (Cobbold); *Strongylus duodenale* (Schneider, 1866); *Dochmius duodenalis* (Leuckart, 1876 *pro parte*). Old World hook-worm.

Description.—In shape this hook-worm is almost cylindrical, the male being about 10 mm. long by 0.45 mm. wide, the female 12 to 13 mm. long by 0.60 mm. wide. The anterior end tapers in both sexes to a fine point. The posterior end of the male widens out into a fan-like form, or bursa, giving it a square appearance.

The color when alive is nearly flesh-red, or cream; when dead, gray or grayish white. The posterior two-thirds is very often red or reddish brown, due to blood in the alimentary canal. The skin is smooth, showing fine transverse striations. Four to eight longitudinal bands run the length of the body. A membranous septum attached dorsoventrally divides the body cavity and supports the alimentary canal.

The alimentary system consists of a mouth and its appendages, esophagus, and a straight canal which extends to the posterior end, having an independent anus in the female, but terminating in a cloaca with the sexual apparatus in the male.

The mouth, on account of the dorsal bend of the body, opens toward the back and the rim is nearly parallel with the long axis of the body. It is semioval, or cup-shaped, the bottom of the oral cavity being flat, uneven, and nearly transverse. A flexible plate gives rigidity and outline to the rim of the mouth. Just within the mouth-cavity on the ventral side are two pairs of sharp-pointed, curved, hook-like teeth; at the base of the cavity on the ventral side are two triangular, pointed teeth or "lancets," and on the front of the dorsal side are two tooth-like bodies separated by a fissure. The lining of the mouth-cavity is thrown into six papillary prominences. In the middle of the dorsal wall the duct of the dorsal esophageal gland opens. From the ventral teeth the two cervical glands extend to nearly the middle of the body.

The triangular esophagus begins at the base of the oral cavity and extends to the gut, at the junction with which is a trilobed valve. Three

nerves run along the esophageal grooves in relation to the three esophageal glands which open into the buccal cavity. At about the middle of the esophagus, on each side, is a small papilla where the duct of the cervical gland opens.

On each side of the anus in both sexes are several "anal glands" which open into the intestine.

The sexual opening of the female is at the posterior third of the body. A short vaginal tube divides into an anterior and posterior uterus, each one being continuous with a narrow ovary lying in transverse folds along the intestine. Ova in great numbers and in different stages of segmentation are seen within the uterus.

The male sexual glands consist of a long, folded tube on each side of the intestine. They reach forward as far as the cervical glands and open into a seminal vesicle situated about the middle of the body. An ejaculatory duct leads from the seminal vesicle to the cloaca, which opens in a papilla within the ventral side of the tail bursa. A "cement gland" covers the duct and elaborates the secretion which fastens the worms during copulation. At the opening of the duct a forked process extends toward the tail and from the opening two long, slender "spicules" extend outward.

The bursa, or umbrella-like expansion of the posterior end, is supported by extensions of the muscular body wall called rays. The bursa and its muscular rays enable the male to firmly grasp the body of the female in copulation.

The ova are 0.056 to 0.061 mm. long by 0.034 to 0.038 mm. wide, oval in shape, with rounded poles. In

fresh stools the ova are usually in four segments and separated by a space from their enveloping shells.

They are similar in appearance to, but smaller than, the eggs of *Ascaris lumbricoides*. The first stages of their cleavage take place in the human intestine, and if the ova are voided so that other human beings may receive them (which is chiefly through the drinking of muddy

hook-worm just described. It is almost as long, but is more slender, the male measuring 7 to 9 mm. and the female 9 to 12.6 mm. The mouth-capsule is small and rounded and the orifice more quadrate than oval. No teeth exist on the free edge, but a broad dorsal and a ventral lip extend inward to or beyond the edge of the membranous lip, forming the margin of the buccal cavity. Two cutting



Greatly enlarged lateral view of the male hook-worm (*Necator americanus*). (Stiles.)
U. S. Public Health Bulletin, No. 32.



Greatly enlarged lateral view of the female hook-worm (*Necator americanus*). (Stiles.)
U. S. Public Health Bulletin, No. 32.

water, where they develop still further), they develop into complete sexual maturity in their final host.

The natural habitat of this parasite is in the upper part of the small intestine.

NECATOR AMERICANUS (Stiles, 1902).—**Synonyms.**—*Uncinaria americana* (Stiles, 1902); *Ankylostoma americanum* (von Linstow, 1903); *Dochmius duodenalis* (R. Leuckart *pro parte*); New World hook-worm.

Description.—This New World hook-worm is regarded as a different species from that of the Old World

plates are found beneath these lips. There are two pairs of ventral teeth and a blunt, conical dorsal tooth projecting from the buccal cavity. The duct of the esophageal gland passes through the dorsal tooth, and at its base are two chitinous plates. The bursa has very long sides and the female genital opening is anterior to the middle of the body. The ova resembles those of the *Ankylostoma duodenale* closely, but are somewhat larger and more tapering.

Development of the Hook-worm.—

The female parasites lay their eggs in the intestine of the host and

they are expelled with the feces. Under proper conditions of moisture, warmth, and oxygen the eggs hatch and the larvæ escape from the shells and feed on the feces. Five moults are passed through during the development of the larvæ before it becomes an adult worm. After the second ecdysis they are "ripe," growth and feeding cease, and they become infectious. At this stage they attempt to get into moist earth, wood, or water, and have a strong tendency to migrate or crawl upon near objects, such as sticks, grass, etc. At this stage they are very resistant to germicides, heat, and cold, and will live a long time if moisture and oxygen is supplied. They possess a wonderful ability to penetrate the skin, to which they can attach themselves even after a short contact. The skin of the foot in bare-footed persons is most frequently attacked, though the buttocks of children who go around in their "shirt tails," ankles, hands, and arms are frequently the sites of infection. The larvæ burrow through the skin, causing a dermatitis which is variously called "water sore," "ground itch," "dew poison," "toe itch," and other names. After entering the subcutaneous tissues they enter capillaries and are carried to the heart. From the heart they pass to the lungs, where they penetrate the capillaries and enter the bronchial tubes. Thence they pass to the mouth and are spit out or swallowed. Their development is then the same as larvæ taken directly into the stomach through food, water, etc. They pass through the stomach uninjured by the gastric juice and into the intestine, where in four or five days be-

gins another ecdysis, during which they acquire a buccal capsule. By means of this capsule the worm fastens itself to the mucosa, from which it derives its nourishment. In four or five days more the last ecdysis begins, the last skin is shed, and the worms, now about one-fifth of an inch long, grow rapidly, and in about six to eight weeks begin to lay eggs.

Symptoms.—The symptoms depend upon the number of worms present and are due to loss of blood and to the absorption of a toxin elaborated by the worms.

The anemia may be so mild in slight infections that it passes unnoticed. In mild infections there are usually indigestion, tenderness, pain and discomfort in the epigastrium, usually of long standing. In children growth is retarded and adolescence is delayed. In severe infections in males the beard fails to grow and in women menstruation is delayed, irregular, scanty, or absent.

The hemoglobin is decreased and may range from nearly normal percentage to as low as 8 per cent. Eosinophilia is common, ranging from 5 to 72 per cent. or more. The erythrocytes in severe cases fall as low as 2,500,000 to 3,000,000 per c.mm. They are paler than normal and stippling is generally found. Normoblasts are often present, but megakoblasts are rare. Poikilocytosis and polychromatophilia occur when the anemia is severe, also anisocytosis. Leucocytosis is not marked. Marked anemia is usually accompanied by albuminuria and dropsy.

The skin is tinged a dirty yellow, is pallid and lacks the normal amount of perspiration. A dermatitis occurs where the larvæ penetrate the skin.

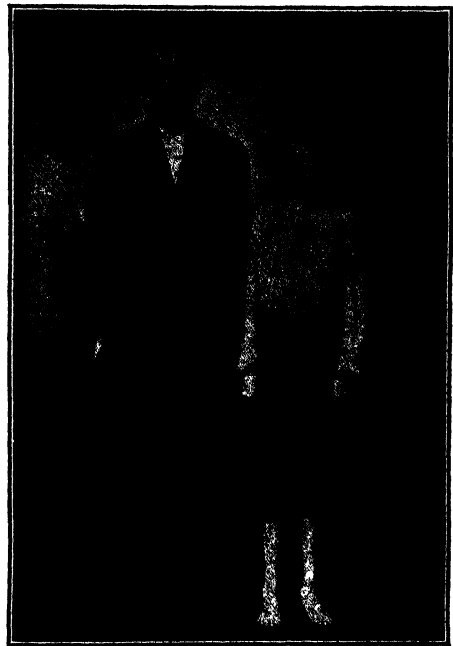
There is at first itching, swelling, and redness. In twenty-four to thirty-six hours vesicles appear and if numerous may become confluent. Pustulation follows vesiculation in about twenty-four to forty-eight hours. Lymphangitis may occur in severe cases and wrinkling of the skin is a prominent feature in long-standing or severe cases.

Except in mild cases, precarious appetite, gastralgia, meteorism, dyspnea on exertion, headache, lassitude, mental torpor, nausea, vomiting, and coated tongue are invariably present. The appetite may be perverted and the infected subjects will crave dirt, charcoal, ashes, coffee-grounds, etc. Palpitation is a frequent symptom and may be severe. A hemic murmur and hypertrophy of the heart may occur. The pulse is rapid and compressible. Pain in the sternum and chest, weakness of the legs and knees, dizziness, tinnitus aurium, pains in the muscles and joints are common.

In marked cases there is edema of the feet and ankles or of the whole body. Bulimia and geophagy are seen. Diarrhea may be present or alternate with constipation. Pulsation of the jugulars or large veins, precordial pain, insomnia, paresthesias, dilatation of the pupils, blurred vision, impotence in males and amenorrhea in females are frequent symptoms. The patellar reflex is often abolished and subnormal or irregular temperature may intervene. Cough, bronchitis, and sore throat are usually present in severe cases for the first ten days after infection. Dyspnea is one of the most common symptoms, especially with a low hemoglobin percentage. Edema of

the lungs and hydrothorax are likely symptoms in severe cases.

Diagnosis.—A tentative diagnosis can usually be made from the history of the dermatitis combined with symptoms of anemia, underdevelopment, weakness, lassitude, and heart symptoms. An eosinophile count is also useful. A positive diagnosis is made by finding the ova in the feces.



Dwarfing effect of the hook-worm. These boys are brothers. No. 1, age 17, weighs 156 pounds; light infection. No. 2, age 18, weighs 74 pounds; heavy infection. (Rockefeller Sanitary Commission Report 1911.)

There is no operculum as in the ovum of the oxyuris.

Pathology.—The principal lesions in ankylostomiasis are ulcerations of the intestines, principally in the duodenum and jejunum, and changes in other organs and parts due to anemia and toxemia.

Treatment. — **PROPHYLAXIS.** — This should consist of measures to prevent infection by exterminating the

mature worms in human beings, and also checking the supply of ova to prevent the growth and existence of larvæ and to obviate infection by them.

Cases with mild or no symptoms — **hook-worm carriers** — should be sought out by boards of health in infected communities, **isolated and treated until cured**. The primary source of infection is the feces. **Stools should be protected from flies and other carriers and disinfected** as scrupulously as in typhoid-fever cases. This would prevent the growth and development of larvæ. To prevent infection by the larvæ, **education of infected communities** on the subject is helpful. **Skin infection** is the most serious danger and persons should be **warned against** exposing the feet or other parts to **contamination** by infected soil, water, etc. They should **not soil the mouth nor eat with muddy hands, should not eat muddy fruit or vegetables, should not drink muddy water or water from muddy receptacles**. In short, they should **avoid handling or using anything contaminated by infected earth or water**. **Earth-eating** should be rigorously prohibited and the **water-supply** be made pure.

In the districts in which this disease occurs, all **drinking-water** should be thoroughly **boiled** and **latrines** should be systematically **employed**.

ACTIVE TREATMENT.—For the dermatitis, the **vesicles** should be **opened, washed, and dressed** with some soothing, antiseptic preparation daily. The patient should be urged to spit out everything coughed up for several days, to prevent swallowing possible larvæ.

No treatment is known which will kill larvæ in the body and prevent them from maturing into worms.

Before vermifuges are given the intestinal canal should be emptied as thoroughly as possible to remove mucus and foreign matter which would protect the worms from the action of drugs. **Rochelle, Epsom, or Glauber's salts, calomel, podophyllin, jalap, senna** are recommended, **sodium sulphate** probably being the best.

After the purging, one of the most widely used drugs for destruction of the hook-worm has been **thymol**. This is given in amounts varying from 10 to 150 grains (0.6 to 10 Gm.) per day, usually in divided doses, finely powdered, in capsules. For children the dose should be in proportion to the age. After three or four hours another purge is given to sweep out the excess of thymol to prevent absorption. Oils should never be used for this purpose, as thymol is soluble in oils and enough may be absorbed to cause harmful results. The patient should **remain in bed** while taking the treatment and should receive **no nourishment** except water until one or two bowel movements have occurred **after the last purge**. The treatment may be repeated in a week.

Stiles approves of 60 grains (4 Gm.) as the standard dose of **thymol** in the adult. **Magnesium sulphate** is given in the evening, half the thymol next morning at 6 A.M., the remaining half at 8 A.M., and salts again at 10 A.M.

Beta-naphthol may be used in place of thymol. The dose is 30 grains (2 Gm.) for an adult. It is less depressing, but is more irritating to the kidneys and may cause dizziness.

Oil of chenopodium, in doses of 15 to 45 minims (1 to 3 c.c.), has been recommended as superior to thymol. It is best preceded by **magnesium sulphate** and followed by **castor oil**, the latter being given 1 hour after the vermifuge.

Carbon tetrachloride is even more dependable than chenopodium or thymol, a single treatment removing 95 to 100 per cent. of the hook-worms. It is nearly tasteless, causes little discomfort and is inexpensive. The dose is 3 minims (0.2 c.c.) to the year of age up to 15, when the adult dose of 45 to 60 minims (3 to 4 c.c.) is reached. It may be given covered with water, in milk, or in soft gelatin capsules, preferably on an empty stomach and followed in 3 hours by **magnesium sulphate**. It is effective likewise against ascaris and trichocephalus. Combined use of 1 part of **oil of chenopodium** with $1\frac{1}{2}$ to 4 parts of **carbon tetrachloride** has been recommended.

Oleoresina aspidii has been used in ankylostomiasis by some.

Oil of eucalyptus in doses of 1.8 c.c. (30 minims) combined with **chloroform** and **castor oil** is useful in bringing away the worms alive.

Podophyllin, **oil of peppermint**, **kerosene oil**, and **guaiacol carbonate** are other drugs stated to be useful.

The anemia and other symptoms should receive appropriate treatment.

FILARIA.—While there are several species of filariæ, that most commonly encountered is the *Filaria Bancrofti*, to the larvæ of which the terms *Filaria sanguinis hominis nocturna*, or simply, *Filaria nocturna*, have been applied.

The adult male *Filaria Bancrofti* is

about 40 mm. ($1\frac{1}{5}$ inches) long and 0.1 mm. ($\frac{1}{250}$ inch) in thickness, while the female is from 80 to 100 mm. ($3\frac{1}{5}$ to 4 inches) long and 0.24 to 0.3 mm. ($\frac{1}{100}$ to $\frac{1}{80}$ inch) thick. From the lymphatic channels of man, in which the adult parasites only are found, embryos or microfilariae arise, which reach the blood-current, but appear in it in large number only at night—or in the daytime if the patient is or temporarily becomes a day sleeper.

The embryo, which is 0.3 mm. ($\frac{1}{80}$ inch) long and, in cross-section, of about the diameter of a red blood-corpuscle, may be present in the blood-vessels in large numbers without causing any symptoms, but the adult worms or ova are apt to block the lymph-channels, producing such conditions as lymph-scrotum, hematochyluria, and probably elephantiasis.

Mosquitoes of varying species (*Culex quinquefasciatus* in Charleston, S. C., and the West Indies), by sucking the blood from a person with this disease, take up the embryos, which develop and migrate within their bodies, finally collecting in the labium, whence they enter the skin of human subjects bitten by the mosquitoes. The filariæ resulting from development of these embryos may cause clinical symptoms in one or two months and begin to produce microfilariae in eight months.

Symptoms.—The majority of persons harboring filariæ have no symptoms.

In chyluria the urine passed is white, opaque, and milky, or sometimes bloody (hematochyluria), with a sediment consisting of a slightly

reddish clot. This condition may exist only intermittently, normal urine being passed for weeks between the attacks. Fat-granules, red corpuscles, and the embryos in the urine are found microscopically.

Manson attributed at least some cases of elephantiasis to the filariæ.

In lymph-scrotum, the parts are very much swelled and thickened. The lymph-vessels are so distended that they are plainly visible and exude a turbid fluid upon puncture.

Diagnosis.—This is made by obtaining blood at night and examining for microfilaria. Where examination in the fresh condition is not practicable, thick film smears may be made, the hemoglobin removed by dipping in water, and the smear then fixed and stained.

Prophylaxis.—This consists of all measures appropriate to prevent transmission by infected mosquitoes.

Treatment.—No effective treatment against the adult filariæ is known. The microfilaria can be killed with intravenous injections of **tartar emetic**, **galyl**, or possibly **neoarsphenamin**, but there is little or no advantage in doing so, these embryos being, apparently, harmless.

In chyluria, the patient should **rest in bed**. **Urinary antiseptics** may be of service by inhibiting bacterial infection. Injections of 2 per cent. **tannic acid** solution into the bladder may be availed of in hematochyluria. **Thymol**, **methylene blue** and **arsphenamin** have been claimed useful by different observers. A dry **diet**, low in fats, has been advised.

Lymphatic tumors large enough to inconvenience the patient may be **removed surgically**, but can be ex-

pected to recur. In operating, unusual care to avoid infection is indicated. Lymphangitis or abscess secondary to filarial infection should be treated in the ordinary way.

DRACUNCULUS, OR FILARIA, MEDINENSIS or **persarum**, or **guinea-worm**, is a thin, thread-like worm, of which the female is 32 to 120 cm. (13 to 48 inches) in length and 1 to 1.7 mm. ($\frac{1}{25}$ to $\frac{1}{15}$ inch) in thickness, while the male is but 22 mm. ($\frac{7}{8}$ inch) long. The cephalic end of the female is rounded off, while the caudal end tapers to a point. The external covering consists of a firm cuticle; the uterus filled with young occupies the chief part of the body cavity. The embryos have a thick covering and pointed tail. They are received into the human stomach through the intermediation of small crustacea and are swallowed through drinking-water. They are thought to pass through the stomach wall and remain in the connective tissue about the root of the mesentery. The male dying after the female is impregnated, the latter travels to the subcutaneous tissues, where she may remain quiescent for a long time and can be felt beneath the skin. The worm contains immense numbers of embryos, which, when ready for discharge, are ejected as a whitish fluid through an ulcerative opening made by the head of the worm, usually near the foot or ankle. Such ejection takes place, in particular, when the skin overlying the worm comes in contact with water. The head of the worm protrudes from the skin. If the embryos reach water, they are engulfed by and develop in small crustaceans of the genus *Cyclops*, and men are infected

by drinking water containing these crustaceans. Infestation with this worm (*dracontiasis*) is not uncommon in Asia and Africa, sometimes occasioning abscesses, especially about the heel.

Treatment.—**Affusions of water** over the skin cause the worm to discharge the contained larvæ. When this process is complete, the worm can be **withdrawn** by careful, gradual traction. The natives harboring such worms remove them in the course of 2 weeks by rolling them up gradually, day by day, around a short stick. If the worm is broken, however, severe infection may ensue. Brumpt advises injection of 1:1000 **mercury bichloride** solution into the worm with a hypodermic syringe, over which the protruding end is tied; next day the parasite is readily withdrawn. Injection of **cocaine** or **chloroform** into the worm has also been advised, and likewise, intravenous injection of **arsphenamin** or **tartar emetic**.

Other less important filariæ are: *Loa* (*Filaria*) *loa*, about 3 cm. long found in West Africa. Its habitat is the connective tissue. *Filaria lentis* has been found in cataracts; *Filaria labialis*, in a pustule within the upper lip, and *Filaria hominis oris*, in the mouth.

EUSTRONGYLUS GIGAS (*Diectophyme gigas*) is a rare parasite found occasionally in the pelvis of the human kidney, which organ may be entirely destroyed. The urine shows blood and eustrongylus ova. The female reaches the length of a meter. It is cylindrical, and red or brownish in color. The anterior end is retracted, the mouth surrounded by six papillæ. In the male, the posterior end is expanded and a spicule projects from the cloaca. This worm is met with in the renal pelvis

in various mammals, including the dog, wolf, horse, cattle, martin, and seal.

STRONGYLOIDES STERCORALIS (*Anguillula stercoralis* or *intestinalis*, *Pseudorhabditis stercoralis*, or *Rhabdonema intestinale*) is a small nematode found in various countries of Europe, especially Italy, occasionally in the South of the United States, and in other territories where the hook-worm is prevalent. It may coexist with the hook-worm, but usually produces little harm. According to N. Barlow, however, a disturbance may be produced comprising 4 stages: (1) Pruriginous skin lesions, due to invasion by the larvæ; (2) latent period; (3) period of diarrhea; (4) period of neurasthenia. The parasite penetrates the crypts of Lieberkuhn, where it deposits its eggs and young, causing disturbances of the epithelium. The treatment is that of hook-worm infestation.

GIGANTORHYNCHUS GIGAS (*Echinorhynchus gigas*) belongs among the thorn-headed worms or Acanthocephala. It is a common parasite of the hog and is stated to have been found in man, particularly in Russia. It is of large size and has as its intermediate host the cockchafer grub and in America the June bug.

TREMATODES (Sucking-worms).

—The trematodes (flukes) are usually flattened, elliptic organisms that attach themselves to certain structures and derive their sustenance by sucking. They are usually hermaphroditic, and their developmental cycle requires the sojourn of the embryo in an intermediate host. When fully developed, they are found, with but few exceptions, in vertebrate animals. The first host is usually a mollusk.

Five species of **liver-flukes** are known to occur in man, viz.: (1) *Fasciola hepatica* or *Distoma hepaticum* (common liver-fluke); (2) *Dicrocoelium lanceatum* or *Distoma lanceolatum*; (3) *Opisthorchis felineus*; (4) *Opisthorchis noverca*—*Distoma conjunctum*; (5) *Clonorchis* (*Opisthorchis*) *sinensis*. The first is the most important.

Fasciola hepatica, the liver-leech, is 28 mm. in length and 12 mm. in width. The worm is flattened, elliptic, with a small head provided with a sucker at the end. A second sucker is found on the ventral surface immediately behind the neck. The sexual opening is between the two suckers. The uterus makes up the chief part of the body and consists of a central tube and lateral branches. The testicular organ consists of a delicate series of coils. The eggs are ovoid in shape, 0.13 mm. in length, and 0.08 mm. in width, from which an embryo develops in water and attaches itself to the snail *Limnaea* in marshes. In this there form radiae or germ-sacks, in which later appear germ-granules. From these are developed cercariae, resembling tadpoles. When these are taken into the digestive tract of ruminant animals, or, as rarely happens, into man, they enter the bile-ducts and sometimes the intestine or inferior vena cava. At times the bile-ducts become obstructed, ulcerative strictures or dilatation are produced, concretions are formed, and inflammatory changes are established in adjacent structures or in the parenchyma. The endemic fluke disease occurring in Japan is characterized by hepatic enlargement, emaciation, diarrhea, and, frequently, ascites. The prognosis is fatal and treatment merely palliative.

The *Distoma*, *Schistosoma*, or *Bilharzia haematobia*, or **blood-fluke**, is very common among the inhabitants of Egypt, $\frac{1}{4}$ of whom are said to suffer from its effects; it occurs also in other parts of Africa and South-western Asia. The male is from 12 to 14 mm. in length, and is stouter and larger than the female, and the body surface is rough and irregular; the female, 16 to 19 mm. in length, is more slender and smoother than the male. They lie for a time in close contact, the female in the *canalis gynecophorus* of the male. Both sexes live in the portal, abdominal, and cystic veins. The eggs are oval, 0.12 mm. in length, with a terminal spine. The embryos are cylindrical, with

conically pointed posterior ends and elongated snouts anteriorly. They are ciliated and motile.

The snail *Bullinus* acts as the intermediary host into which the ciliated embryo bores its way and becomes capsulated. Infection occurs through the skin of bathers and probably through drinking water containing the larvæ. The parasites are found in the portal vein and its branches, the splenic and mesenteric veins, and in the blood-vessels of the bladder and rectum. The impregnated females travel to the bladder or, much less frequently, to the rectum, lungs, liver and kidneys, where the ova give rise to irritation, ulceration, concretions, and neoplasms. The first and most constant symptom is usually hematuria, which gradually leads to anemia. In severe cases, however, there may be an initial stage of toxemic manifestations and urticaria, and at times frequency of and pain on micturition set in before the hematuria. The diagnosis is made by finding the large ova in the urine, or sometimes by cystoscopy or the X-ray. Severe cystitis or septic pyelonephritis may result from this disorder, but much oftener, spontaneous recovery occurs in 2 or 3 years. Proctitis, with mucous and bloody stools and tenesmus, may result from lodgment of the parasites in the rectum. There is slight leucocytosis and marked eosinophilia.

Schistosoma Mansoni, a different species of blood-fluke, is the cause of *intestinal bilharziasis*. The worms themselves are very similar to *S. haematobia*, but the ova are readily distinguished by having a lateral instead of a terminal spine. These ova accumulate in the walls of the large bowel and the liver, giving rise to dysentery, with or without pain, or sometimes to constipation. Various intestinal complications may

occur, and at times hepatic cirrhosis, irritability and impaired mentality. The prognosis is usually favorable. With this parasite the ova discharged from the bowel develop in snails of the genus *Planorbis*. The disease is prevalent in Africa, the West Indies and South America.

Schistosoma japonicum *vel* *Callo* is the name given to a parasite inhabiting the veins or arteries of the intestine or other organs of some of the inhabitants of China, Japan, and the Philippine Islands. It causes a disease characterized by progressive anemia, cirrhosis of the liver, ascites, splenomegaly, dysentery, cystitis, and occasionally localized epilepsy. In Japan it is called the "Katayama" disease. It is fatal in about 10 per cent. of the cases.

The treatment of each of the above forms of *Schistosoma* infection consists of intravenous injections of **tartar emetic** or of **sodium antimony tartrate**. Lasbrey and Coleman recommend, for male adults, an initial dose of 1 grain (0.06 Gm.), increased by $\frac{1}{2}$ grain with each injection up to $2\frac{1}{2}$ grains (0.15 Gm.); injections are given daily for 6 days, then on alternate days up to 12 injections. Cawston advises that $1\frac{1}{2}$ grains of tartar emetic be not exceeded except in those who stand a larger dose without a reaction. **Emetine** intramuscularly, $\frac{1}{2}$ to $1\frac{1}{2}$ grains (0.03 to 0.1 Gm.) on alternate days for 28 days, is also an effective remedy. In the cases involving the bladder, occasional irrigations of that organ with 1:3000 **silver nitrate** or 2 per cent. **mercurochrome** solution are of service.

Prophylaxis consists in **abstinence from bathing in infected water** and in **boiling the drinking-water**.

The *Distoma pulmonale*, *Paragonimus Westermanni*, or **bronchial fluke**, is a club-shaped parasite 8 to 16 mm. in length. It is found encysted, usually two in each cyst, with ova. Ova are produced in large numbers and discharged from the lung in the

sputum. The ova are operculated, dark-brown, thick-shelled and vary from 85 to 100 micra in length by 50 to 67 micra in breadth. There are believed to be 2 intermediate hosts, a water snail and a fresh water crab or crawfish. It is found especially in China, Japan, and Formosa. It has also been found in hogs in sections of the United States, and in tigers, dogs, and cats. Its presence results in cough, hemoptysis, and the occurrence of small flukes in the expectoration, which will differentiate it from pulmonary tuberculosis. As to treatment, **emetine** may be tried. Prophylaxis consists in avoiding raw or insufficiently cooked crustaceans.

The *Fasciolopsis (Distomum) Buski*, the *Heterophyes (Mesogonimus) heterophyes*, and the *Gastrodiscus (Amphistomum) hominis* are occasionally found as human intestinal parasites.

CESTODES (Tape-worms).—Cestodes are flat worms like white tape, devoid of mouth or intestine. They increase by alternate generation, through the germination of the pear-shaped scolex, or head, and remain attached to it as a long, band-shaped colony of proglottides.

Each proglottis is in itself a complete sexual animal, containing a large branched uterus, ovaries and testicular structures with vasa deferentia. The sexual opening is at the side of each proglottis in the teniæ and at the inferior edge in the bothriocephali. Each segment when ripe contains thousands of ova, some of which pass into the feces and some pass out with detached segments. The ova when ingested by an appropriate host develop into embryos in the intestine and from there pass to the voluntary muscles or other tissues, where they develop into larvæ or cysticerci (scolices) inside of cysts.

The pear-shaped primary form (scolex, or head) has from two to

four suckers, and is provided also with claw-like, curved hooks. By means of these adhering organs the tape-worms fasten themselves to the intestinal wall of their immediate host, which is always one of the vertebrate animals. The scolices develop from a round embryo with four to six hooks, and are found as so-called "measles," chiefly in parenchymatous organs. Later by means of passive migration they move out of these organs into the intestine of their future host.

Tape-worms which occur as parasites in man belong to different families known as (1) the *teniæ* and (2) the *bothriocephali*.

Tenia Solium (Pork Tape-worm).

—The hosts for this parasite are the hog and man. When fully developed this worm is from 2 to 3 meters in length. Its head is spherical, the size of a pinhead, with a projecting rostellum armed with a double row of hooklets, and has four permanent sucking-cups. The crown of the head is often pigmented. Next comes a filiform neck about 1 cm. long. A division into segments commences at a certain distance from the head, of which there may be 200 to 450. The first segments are short, but their length increases from before backward. They are first square, then longer than they are wide.

The mature segments begin about 130 cm. behind the head. The sexual organs are fully developed in the earlier segments. The mature segments when stretched are from 9 to 11 mm. long, and from 6 to 7 mm. wide, with rounded corners.

The parenchyma of the body of both mature and immature tape-worm segments is divided into two chief

layers, viz.: (1) central, or middle, layer; (2) peripheral, or cortical, layer.

The middle layer includes the sexual organs, also an excretory apparatus that traverses the whole tape-worm from the head to the last segment in the form of two canals. The canals are connected at the posterior end of each segment and send subdividing branches to the parenchyma.

The sexual apparatus consists of male and female sexual organs lying close together. The germ-preparing organs consist of a double ovary and a single albuminous gland. When the eggs enter the uterus from the globular body in which the first stage of development occurs, the lateral branches sprout forth and become filled with eggs. The eggs in the ovary are pale-yellow, globular cells. In the uterus they become yellowish balls with a thick, opaque shell. This shell frequently has a second envelope, and in it are imbedded nuclei. These thick-shelled balls are no longer eggs, but contain an embryo with six hooklets. While still in the uterus, development of the embryo takes place, and the segments are here impregnated. The eggs, when ripe, measure about 0.03 mm. in diameter, are ovoid in shape and have a thick shell that is radially striated. The further development of the embryo does not take place in the same host that shelters the tape-worm. If the embryos reach the stomach of the pig, the egg-shell becomes dissolved, the embryos are liberated, and bore their way into the wall of the stomach or intestine. They proceed by way of the blood or active migration into different organs. Having found a lodging-place, the embryo

undergoes changes and becomes in two or three months a cyst filled with serum, from whose wall there shoots forth, like a bud, toward the interior a scolex; from this a new tape-worm head develops, and also a sac enveloping it. The cyst with tape-worm head is called a "measle," or *Cysticercus cellulosa*. The scolices when fully developed possess a circle of hooks, suckers, water-vascular system, and numerous calcareous bodies in their body parenchyma. If they enter the human stomach, the cyst dissolves, and develops, through formation of segments from their primary host, a new chain of proglottides, a new *Tenia solium*. The *Tenia solium* occupies the small intestine in man, and is acquired by eating uncooked pork.

The "measles" of this parasite occur almost solely in human beings and swine. There is generally only one parasite in the intestine, but there may be more, as many as 30 or 40 having been found in one individual. They cause irritation of the intestinal mucous membrane, colic, and reflex disturbances of the central nervous system.

In the tissues of swine the "measles" are sometimes single, often numerous, and single organs like the heart may be thickly sprinkled with them. In man the cysticerci occur in varied tissues, as the muscles, brain, eyes, skin, etc. In the brain they may appear as a collection of cysts like bunches of grapes, called *Cysticercus racemosus*. The cysts are mostly sterile, but some may contain a scolex.

The importance depends upon their location, but is generally slight, and even when in the brain does not always cause trouble.

Locally a slight inflammation is excited which causes a thickening of the connective tissue in the vicinity of the cyst. After the death of the scolex the cyst shrivels up, and within it there is a chalk-like mass. In this mass the hooks remain a long time. Infection with the "measles" follows the presence of the eggs, or proglottides, in the human stomach.

***Tenia Mediocanellata* (or *Saginata*).**

—This worm surpasses the *Tenia solium* in length, breadth, and thickness, as well as in size of the proglottides. The head is about 2 mm. broad and without a circle of hooks, but has a flat crown and four large suckers, which are generally surrounded by a black fringe of pigment. It is nearly white in color. The eggs are similar to those of the *Tenia solium*. The "measles" are found in the cow, chiefly in the muscles and heart, more rarely in other organs, and are smaller than in swine. The development follows a similar course to that of the *Tenia solium*. This worm is more widespread than the *Tenia solium*, and human beings acquire it by the consumption of raw beef. Usually but a single worm exists, but as many as forty have been found in a single host. Man may become infected by either embryos or scolices, but strobiles never develop in cattle.

***Tenia Cucumerina* (or *Elliptica*—*Dipylidium caninum*).**—This worm is from 15 to 20 cm. long, and possesses a rhomboid head with a retractable rostellum bearing four circlets of hooks. The segments are elongated and elliptic in shape, each having a double genital apparatus with a sexual opening on each side. It occurs frequently in dogs and cats, but seldom in man.

Its cysticerci infect the louse and

flea of the dog; more rarely, the flea of human beings.

Diphyllobothrium latum (Dibothriocephalus Latus) or Pithead.—This is the most formidable tape-worm of man, and measures from 2 up to 10 meters in length. It is made up of from 3000 to 4000 short, broad segments. These are broadest in the middle region, and grow narrower toward the end. The length of the largest segment is 3 to 5 mm.; width, 10 to 12 mm.

The head has an elongated oval or club shape. It has on each lateral border a slit-like depression, which acts as sucker, and is mounted on a filiform neck. There are no hooklets. The body is thin and flat like a ribbon, except the central parts of the segments, which project outward. At this point the uterus, in the shape of a simple canal, is found. When the ova collect here in great numbers, the lateral coils of the uterus arrange themselves in knots, producing a rosette-like appearance. The sexual orifices lie in the median line of the ventral surface. The ovary is a double organ, which lies in the middle layer. The testicles consist of clear vesicles lying in the lateral part of the middle layer. The eggs are oval, surrounded by a thin, brown shell, are larger than those of the *Tenia solium* and *Tenia saginata*, and have a lid-like structure at one end.

The *Diphyllobothrium latum* is found in Switzerland, northeastern Europe, Holland, and Japan. Bollinger says it is quite common in Munich. It lives in the small intestine of man. The first development of the eggs takes place in water. Months afterward an embryo develops, armed with hook-

lets, and covered with minute cilia. This develops in a crustacean intermediate host into a "measle," which then seeks out as a mediate host the pike, ling, perch or one of certain other fresh water fishes, and either in the intestines or muscles of these fishes develops into a larva or plerocercoid 1 to 2 cm. long.

The so-called "measle" of the *Diphyllobothrium latum*, according to Grassi and Parona, in Italy seeks out the pike and river perch. It is found in a Japanese fish, and in a variety of fishes in the Lake of Geneva, most often in the perch. The larva may also develop into a worm in the dog or cat.

The presence of the *Diphyllobothrium latum* in the intestine of man may give rise to a progressive anemia, resembling pernicious anemia. It is to be noted that, contrary to other verminous parasitic diseases, eosinophilia does not occur. How it causes a diminution of the red blood-corpuscles and the percentage of hemoglobin in the blood is unknown, but this is believed due to toxins elaborated by the worm. Tallqvist has shown that this parasite contains a lipid having hemolytic power.

Tenia Nana (*Hymenolepis nana*).—A small tape-worm 5 to 45 mm. long, found in Egypt, Italy and the Southern United States. It has a retractable rostellum, four suckers and a circle of hooks. The segments number about 200 and are broader than long. It is found in dogs and cats and is not uncommon in children, in whom it possibly causes enuresis nocturna and epileptiform convulsions. According to Grassi, it can develop from eggs without an inter-

mediate host, though possibly insects and snails may act as such. **Male fern, oil of chenopodium and thymol** are useful remedies.

Hymenolepis diminuta (*Tenia flavopunctata*; *Tenia leptocephalata*).—This is a small cestode, 20 to 60 cm. long, with a club-shaped head and 800 to 1300 segments. It is common in rats and has been found in man. The cysticerci (larvæ) develop in caterpillars, earwigs, and beetles.

Tenia confusa and *Davainia* (*Tenia*) *madagascariensis* are cestodes occasionally found in man.

Symptoms.—Tape-worms are found in human beings of all ages, but they are by means common in children. Holt's statistics are very conclusive on this point: of 10,000 cases studied, only 79 gave undoubted evidence of tape-worm. Cestodes may cause no disturbance whatever, and yet sometimes induce grave phenomena, such as profound anemia, malnutrition, and nervous symptoms. There may be anorexia, voracious appetite, constipation or diarrhea, colicky pains in the abdomen, indigestion, nausea, vomiting and lassitude. When evidences of their presence are discovered, they are liable to produce much anxiety. In nervous folks there follows frequently profound mental depression and hypochondriasis. *Tenia* produce convulsions, choreic symptoms, pruritus of the nose and anus, vertigo, migraine, and tinnitus aurium, especially in children. The diagnosis need never be difficult; the presence in the stools of segments of the worm or ova can be demonstrated by a careful search, and these are readily differentiated.

Treatment.—Prophylaxis should

consist in the use of **well-cooked food and pure water**. **Feces** of infected patients should be **burned** and the **meat-supply rigidly examined**. For the treatment of the intestinal cestodes it is necessary to prepare the patient, who should take a very light diet for two days. A large enema of **cold water** or a thorough **saline purge** should be given. No breakfast should be taken on the day the anthelmintic is to be administered. Of the various remedies advocated, the best is, perhaps, **pelletierine**, but this is not suitable for children and is expensive. The dose is 4 to 8 grains (0.25 to 0.5 Gm.) with 5 grains (0.3 Gm.) of **tannic acid** in sweetened water.

For children, most authorities recommend the **oleoresin of male fern**, four doses of 15 minims (0.9 c.c.) each in capsule given at intervals of an hour and followed by an active purge, such as **castor oil**. It must be borne in mind that filicic acid dissolves more readily in the presence of castor oil, and may thus cause considerable constitutional disturbance. Gross noted a case of blindness in a man, followed by optic atrophy, thus induced, and Mazius, two cases of partial amaurosis. For adults the maximum dose of the **oleoresin of male fern** is 2 drams (8 Gm.).

R. Oleoresin of male

fern 3ij (8 Gm.).

Powdered jalap ... gr. viiss (0.5 Gm.).

Simple syrup, q.s. ad f3j (30 c.c.).

Sig.: Shake well and take at one dose.

(Schilling.)

The dose required can be considerably reduced by giving it through a **duodenal tube**, thus obviating all risk of toxic effects (Schneider).

It is customary to combine **male fern** with an infusion of pomegranate-

root or pumpkin-seeds. Osler recommended an infusion of **pomegranate-root**, $\frac{1}{2}$ ounce (15 Gm.); **pumpkin-seed**, 1 ounce (30 Gm.); **powdered ergot**, 1 dram (4 Gm.), and boiling water, 10 ounces (300 c.c.). An emulsion of 1 dram (4 c.c.) of the ethereal extract of **male fern** containing 2 minims (0.12 c.c.) of **croton oil** is then made. After using a low diet on the previous day and an efficient **laxative** that night, the emulsion and infusion are mixed together and taken, fasting, the next day.

Pumpkin-seeds alone are very efficient. Three to 4 ounces (90 to 120 Gm.) should be carefully bruised, and macerated for half a day and the entire amount of the infusion taken and followed in an hour by a purge. Copper oxide in doses of $1\frac{1}{2}$ to 3 grains (0.1 to 0.2 Gm.) three times a day, for several days, is recommended by Sasse, the only restriction being the avoidance of acid drinks. A purge is given at the end of a week. An infusion made of $\frac{1}{2}$ ounce (15 Gm.) of the flowers of **kousso** (*Brayera anthelmintica*) to a pint of water (500 c.c.) and mucilage of acacia is a good remedy and is given in the dose of a wineglassful every half-hour. **Kous-sin** in 30- to 40- grain (2 to 2.6 Gm.) doses may be used, but is contraindicated in pregnancy. Powdered **kamala** in 1- to 3- dram (4 to 12 Gm.) doses in wine or water, **oil of turpentine** in doses of $\frac{1}{2}$ to 2 ounces (15 to 60 c.c.) in emulsion or milk, and **thymol** are also useful.

Unless the head is brought away, the segments of the parasite reproduce themselves, and in three or four months show in the feces. Where the head and neck are protected beneath the *valvulæ conniventes*, the remedies

may not reach the parasite. Unless the worm is killed, it is probable that no degree of peristalsis can dislodge the head. This is especially true of the *Tenia solium*. A good device is to place warm water in the vessel into which the dejecta are received, as it is thus more likely to be preserved entire.

VISCERAL CESTODES.—The larval forms of certain of the tape-worms invade the solid organs and produce important symptoms. The two varieties which more commonly occur in man are, first, the *Cysticercus cellulosæ*, the larva of the pork tape-worm, or *Tenia solium*; and, second, the *echinococcus*, the larva of the *Tenia echinococcus*. The *Cysticercus tenia saginata* has been known to occur in man, but is very rare.

Cysticercus Cellulosæ.—The ripe ova of the *Tenia solium* are occasionally received into the human stomach either by being accidentally swallowed or forced into the organ from below. The human then becomes the intermediate host of this cestode, which is usually the *Sus domesticus*. It thence invades various tissues and organs. Pigs are sometimes found swarming with these "measles," and in them there is rarely any constitutional disturbance except possibly at first. If in man only a few of these "measles" become established, the larvæ may die, become calcified, and produce no mischief. They are very rare in America. The symptoms produced where a considerable number occur or where the localities invaded are sensitive are sometimes very serious, and are divided by Osler into general, cerebrospinal, and ocular. The *general* symptoms resemble in many instances a peripheral neuritis.

When the *cerebrospinal* tissues are involved, very pronounced symptoms may result, according as the centers are invaded or the more silent regions are occupied. The *ocular* symptoms can be more or less readily elucidated by a direct examination of the eye, as the presence of the cysticercus in the vitreous humor has been frequently noted.

ECHINOCOCCIC DISEASE.—

This disorder, both general and local in its manifestations, arises from the invasion by the larval forms of the *Tenia echinococcus* of the liver, intestinal canal, lungs and pleuræ, kidneys, bladder, genitalia, brain, spinal cord, bones, heart, and blood-vessels, and occasionally other organs.

In America this disease is extremely uncommon and even then occurs only in foreigners with rarest exceptions. It prevails in countries where man lives in intimate association with dogs, as in Australia, Iceland, and some parts of Europe.

The *Tenia echinococcus* lives in the intestinal canal of the dog. It is 4 mm. long, and has only four segments, of which the posterior one surpasses in length all the others put together, and alone is mature. The head is provided with four sucking disks and a rostellum with a double row of hooklets 30 or 40 in number with coarse root-processes. Only the cyst-worm is found in man, and sometimes in the hog, ox, horse, and sheep.

The development of the embryo takes place in the stomach or intestine, where the shell of the ovum is digested away; it then burrows through the intestinal wall, arriving at the peritoneal cavity or the muscle; or, falling into the portal circulation, it may be carried to the liver, which,

in at least one-half of the cases, is its destination. Again, it may enter the systemic vessels and be carried to various organs and regions of the body. Upon reaching its destination the six hooklets with which it is originally equipped disappear, and a cyst is formed, presenting two layers: an external, laminated, cuticular layer or capsule, and an inner, granular, parenchymatous layer or endocyst. These embryonal cysts grow and bud, develop from the parenchymatous layer, and themselves become cysts similar to the first one. Thus, the parent-cyst as it grows may contain a dozen or more daughter-cysts, inside which last again a similar process occurs, and a series of third or grand-daughter-cysts in time develop. From the lining membrane brood-capsules arise by budding; these mature into scolices, which are found to be heads of the *Tenia echinococcus*, presenting four sucking disks and a circle of hooklets. Should a scolex reach the intestines of a dog, it may develop into a similar tape-worm.

An interesting and important difference between the natural history of the *Tenia solium* and the *Tenia echinococcus* is that the ovum of the former develops into a single larva, whereas that of the latter forms a cyst which amplifies itself enormously, and from the lining membrane of which millions of larval echinococci are in turn produced.

In man, as a rule, the growth of the echinococcus is, as described, endogenous, the secondary and tertiary cysts being contained within the primary; in animals, however, the development may be exogenous. The primary cyst penetrates between the layers and matures externally. A third form is

the multilocular echinococcus, occurring in the liver only where the primary cyst-bud develops and is cut off entirely, becoming capsulated. These joining together produce a dense mass composed of connective tissue inclosing spaces in which are found remains of the echinococcic cyst oftentimes sterile: *i.e.*, without heads or larvæ. It resembles cancer, and the symptoms are those of tumor. The echinococcus lives a varying time, oftentimes many years. The usual change is death and inspissation of the contents and the transformation into a mass of partially calcified granular material. They may, however, rupture into a serous sac or external perforation, whereupon the cyst is discharged into a bronchus or the urinary passages or the bile-ducts or blood-vessels. From these effects death may follow very suddenly or recovery may ensue. Suppuration may become established, and large abscesses are sometimes formed, which contain hydatid membranes.

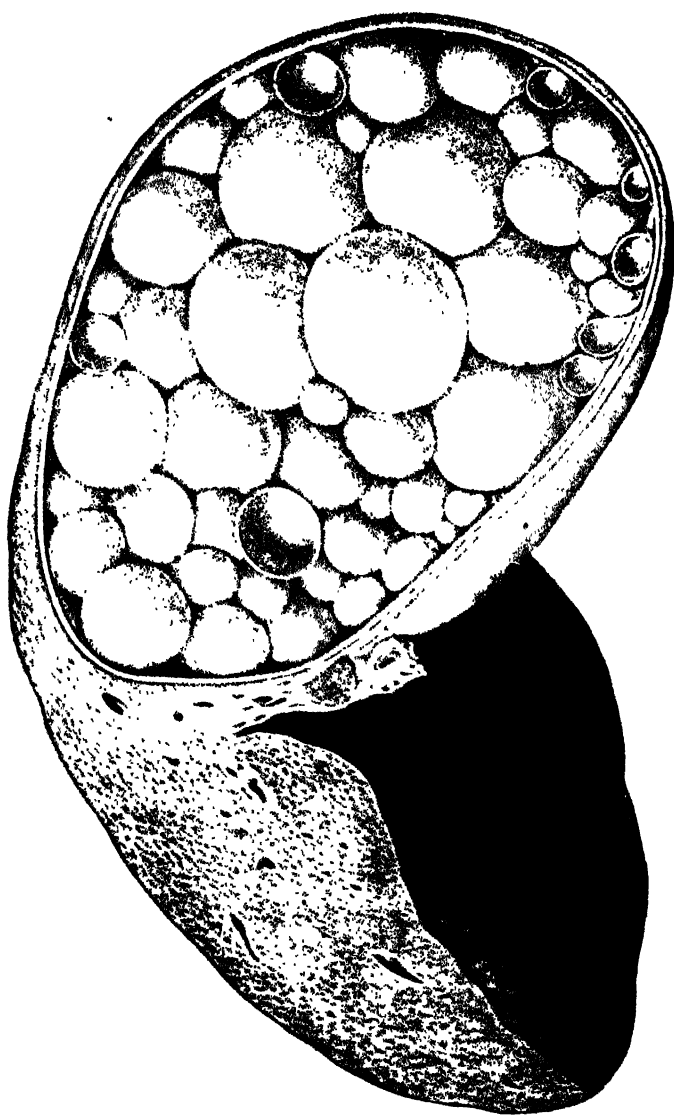
Symptoms.—About 50 per cent. of hydatid cysts are found in the liver. When these are of considerable size, the tumor or tumors are detectable by palpation and otherwise, the size of the organ being sometimes markedly increased. When these are small, they may not be distinguished or give rise to any disturbances. When they occur in the epigastric region on the anterior surface of the organ, they can be distinctly appreciated by touch, a feeling of density and occasionally a fluctuation being sometimes elicited. Occasionally they are found near the left suspensory ligament, disturbing the position of the heart upward, and an area of percussion dullness can be demonstrated in

the lower sternal and the left hypochondriac regions. If the tumor occur in the posterior surface of the right lobe, the liver is enlarged upward, encroaching upon the pleura, and the area of dullness in the axillary line is higher. A percussion fremitus can be detected if the cyst lies very subcutaneously. This consists of a tremulous or vibratory movement conveyed to the fingers of the left hand while percussing at the same time with the right.

Subjective symptoms of pressure or dragging and occasionally pain are experienced in the region of the liver; little more disturbance is caused than this. Where suppuration occurs, there are the usual symptoms of pyemia, along with jaundice and rapid emaciation. Perforation may take place externally or into the stomach, colon, pleura, or the bronchi; where this is into the pericardium or inferior vena cava, it is, of course, fatal.

Renal colic may be caused by cysts or portions of the membrane blocking the ureter. The lung is affected in about one-fifth of the cases, the symptoms being those of pneumonic compression along with displacement of the heart. The pleura is sometimes primarily affected, the signs being those of an ordinary effusion; but the line of dullness is generally quite irregular and there is rarely set up an acute pleurisy.

Echinococci of the lung may, when small, cause very little disturbance, but when large the symptoms of compression obtrude themselves; inflammatory changes may be set up, resulting in hemorrhage, gangrene, and cavity formation. Perforation of



Echinococcus Colony in the Liver. (Semischematic.)

the pleura with empyema is common, but this is rare.

Abscess of the liver caused by the echinococcus is obviously a serious disorder. In a large number of cases which come to autopsy the parasite is found to be dead.

The kidney is sometimes infested by the echinococci, and symptoms are set up resembling an hydronephrosis.

The nervous system is occasionally affected, especially the brain, causing vague symptoms of tumor, as headache, convulsions, and blindness.

Diagnosis.—To differentiate between hydatid cysts and other tumor masses, exploratory puncture has been resorted to. In some instances hooklets may be found in the fluid, which, as a rule, is clear, of a neutral reaction, varies from 1.005 to 1.009 in specific gravity, and contains sugar. This procedure, however, entails risks of infection, secondary echinococcus of the peritoneum, and hydatid intoxication. Brumpt warns that even aseptically conducted puncture may bring in bile containing colon bacilli and thus start suppuration. Hence, puncture had best be avoided and reliance placed on the more modern procedure of examination with the X-ray, to which hydatid cysts are opaque, and of special tests, *viz.*, the complement fixation, precipitin, or intradermal tests (see under LIVER: HYDATID CYST, Volume VI).

Between hydatid disease and cancer of the liver it is difficult to distinguish except through the clinical history. A syphilitic tumor of the liver is firm and rarely fluctuates. From hydronephrosis, for which hydatid disease of the kidney is readily mistaken, the latter may at times be distinguished

through the discovery of small cysts in the urine.

Prophylaxis.—This consists in the incineration of infected material in the slaughter houses; the prevention of ingestion of infected material by dogs, and, by way of personal prophylaxis, the avoidance of contact with, and especially licking by, dogs.

Treatment.—No effective internal treatment is known. Aseptic aspiration of the contents of the cyst may be followed by recovery, but is attended with the risks already alluded to under Diagnosis; aside from this it is often followed by recurrence. The procedure of choice, therefore, is surgical removal of the cyst. By careful incision of the outer cyst wall, it may be possible to remove the inner cyst or parasite in its entirety. Some surgeons resort to marsupialization of the cyst cavity. Where suppuration exists, treatment as for abscess is indicated.

STOMACH PARASITES.—Parasites of the stomach are not common. Occasionally the *Ascaris lumbricoides* and the *Oxyuris vermicularis* may enter the stomach, but it cannot be considered their natural habitat. The larvæ of certain insects seem to be able to cause gastritis. Occasionally fungi, as the favus, may grow in the stomach, and rarely the tubercle bacillus and *Treponema pallidum* may be gastric parasites. Sarcinæ and yeasts may be found in gastric cancer and dilatation.

PROTOZOAN INFECTIONS.—The protozoa, or unicellular animals, are divided into the spirochetes, the rhizopods, the sporozoa, the flagellates, and the infusoria. The pathogenic spirochetes include those of syphilis, relapsing fever and icterohemorrhagic spirochetosis, which will be found mentioned under separate headings. The rhizopods include the pathogenic amebæ, alluded to under DYSENTERY. The medical aspects of the remaining three classes may be briefly taken up here.

SPOROZOAN INFECTIONS.—Aside from the parasites of malaria (see **MALARIAL FEVERS**), various sporozoa (psorosperms) have been found in man. To the group of disorders produced the term **psorospermiasis** has been applied. In internal psorospermiasis the liver is most frequently the seat of the disease, which, produced by *Coccidium oviforme* (*Eimeria Stiedai*), is similar to that caused by the same parasite in the rabbit. Fever, chills, malaise, drowsiness, and unconsciousness have been noted in infected patients. The liver is tender and nodules may be palpated. Silcott reported a case in a woman, aged 53, who had a chill, intermittent fever, diarrhea, nausea, dry tongue, and tenderness over the liver and spleen. Post-mortem examination showed an enlarged liver and spleen containing caseous foci or nodules. The ileum presented six papular nodules containing coccidia. The parasites have also been found in the kidney and ureters, causing frequent micturition and hematuria.

In external psorospermiasis, a dermatitis characterized by hard, crusty papules, resembling a tuberculous infection, is found on the skin of the face, lumbar, abdominal, and inguinal regions, or on any part of the body. This was formerly called *keratosis follicularis*, and it is not yet known whether it is due to protozoa or certain fungi.

Another pathogenic sporozoan is *Bartonella bacilliformis*, the active agent in **Oroya fever**, a disorder occurring in Peru and featured by a series of brief febrile movements continuing over several weeks, with joint pains, increasing anemia, and death in 10 to 40 per cent. of the cases.

Among other sporozoa occasionally found in man, but of doubtful pathogenicity, are *Eimeria oxyspora*, *Eimeria Wenyoni*, *Iso-spora hominis*, and various species of *Sarcocystis*. To *Rhinosporidium Seeberi* are ascribed certain polypoid tumors of the nose, ears, conjunctivæ, and penis, reported from various lands, including the United States.

FLAGELLATE INFECTIONS.—The flagellates are provided with one or more flagella and sometimes with an undulating membrane. This class includes the several species of *Leishmania*, causing kala-azar (q.v.) and other leishmanioses, as well as several species of *Trypanosoma* (see **TRYPANOSOMIASIS**). It also includes *Blastocystis*

hominis, an organism with large central vacuole, harmless, present in nearly all human subjects, and frequently mistaken for cysts of protozoa or for amebæ.

Trichomonas vaginalis, likewise a member of this group, is a rounded parasite 10 to 23 micra long, with 3 or 4 flagella, a narrow undulating membrane, and an oval nucleus. It is not uncommon in vaginal secretions. Destruction of this parasite and cure of the vaginitis which it seems to favor is obtainable by injection of 1:1000 iodine solutions (Escomel).

Trichomonas intestinalis (*Cercomonas hominis*) is somewhat almond-shaped, 10 to 15 micra long, with 3 to 5 flagella at the anterior end and a well-marked undulating membrane projecting posteriorly. This protozoan occurs in the large bowel in man, reproduces by longitudinal fission in the cecum, and when present in large numbers, may cause acute or chronic diarrhea associated with pain. For the destruction of this parasite, Escomel recommends oil of turpentine, 2 to 5 Gm. (30 to 80 minims), with **paregoric**, 8 to 12 Gm. (2 to 3 drams) in a menstruum containing acacia and syrup, 120 Gm. (4 ounces); one teaspoonful every 2 hours for 3 days.

Giardia (*Lamblia*) *intestinalis* is a pear-shaped organism 10 to 20 micra long, presenting anteriorly, on its ventral aspect, a rounded depression surrounded by 6 backwardly directed flagella. There are also 2 flagella at the pointed posterior end of the protozoan. Upon staining, 2 nuclei, side by side, are prominently seen in the anterior half. This parasite has a wide distribution, more especially in tropical countries, though not infrequently found in Europe and the United States. The parasite issues from infected subjects mainly in the form of ovoid cysts containing 4 nuclei. It becomes pathogenic in about 10 per cent. of those who harbor it (Brumpt). The parasites are especially numerous in the duodenum.

Enterocolitis due to *Giardia* is occasionally acute, resembling that of amebic dysentery, but is not improved by emetine. Usually it is chronic, with copious, very soft, mucoid, alkaline stools with a putrid odor. There may be constipation and irregular bowel movements. The parasites may also invade the bile-ducts and

gall-bladder. Marcellus mentions as usual symptoms: Pain and tenderness at the costal margin and in both sides, sometimes more pronounced on the right; nausea on eating and occasionally vomiting; loss of weight; weakness and neurasthenia.

Numerous drugs have been tried in giardiasis, with little or no effect. According to Castex and Greenway, a remedy of some use is **stovarsol**, preceded by **cholagogues** or **bile extracts**. The stovarsol is given in tablets of 0.25 Gm. (4 grains) each: 3 tablets daily for 3 days, then 3 days' rest, next 3 tablets daily for 3 days, and finally 15 days' rest, after which, if the stools still contain *Giardia* cysts, the series is repeated. Lyon and Swalm obtained apparent cure in a small proportion of cases with weekly **biliary drainages** with **magnesium sulphate** intraduodenally, followed by transduodenal lavage with 500 c.c. of 1 per cent. **dimol**. In one instance **neoarsphenamin** was used intraduodenally in doses of 0.3 to 0.45 Gm.

INFUSORIAL INFECTIONS.—The infusoria are provided with numerous cilia, a vegetative macronucleus, and a reproductive micronucleus. Of clinical import is:

Balantidium coli (*Paramacium coli*), an ovoid organisms 30 to 200 micra in length, with an oblique groove at the narrower anterior end, and bearing over the whole body fine longitudinal striæ along which numerous cilia are inserted. Balantidiasis is common in the Philippines, India, Scandinavia and Finland, as well as in extensive portions of Asia, and a number of cases have been observed in the United States. Hogs harbor this parasite, and are believed to be the source of human infections. The clinical manifestations are those of chronic colitis. According to Kolisch, fever and eosinophilia may arise before there is much destruction of the intestinal submucosa. The disease persists for years and is stated to be fatal in over 20 per cent. of the cases. Most of those who harbor the parasite, however, are healthy carriers.

While obstinate, the infection is somewhat less difficult to cure than giardiasis. Flushing of the colon with a 0.1 to 0.5 per cent. **quinine sulphate** solution for several weeks may prove successful. To these Kolisch adds large doses of **acidol-pepsin** by mouth, while Bellard gives 3 drops of **Lugol's solution** 3 times a day. Pick gives

papaverine for pronounced colic. Greene and Scully recommend an exclusive **milk diet** for several days, with **bismuth subnitrate** for cramps and diarrhea, and later **stewed fruits** until the feces are free from the parasite (8 to 20 days).

J. MADISON TAYLOR

AND

FRANK E. FREEMAN,

Philadelphia.

PELLETIERINE AND POMEGRANATE.

—Pelletierine, or punicine, is a mixture of alkaloids obtained from the root-bark of the pomegranate (*Punica granatum*, L.), or *Granatum*, U. S. P. It occurs as a colorless, oily liquid, of aromatic taste and odor. It readily forms salts, of which the tannate is most commonly used. The tannate occurs as a light yellow, amorphous hygroscopic powder, with a slight astringent taste and weak acid reaction. It is soluble in 12.6 parts of alcohol, in 250 parts of water, and in warm dilute acids. Tanret's pelletierine is a syrupy solution, sold in bottles, each containing one dose.

PREPARATIONS AND DOSES.—*Granatum*, U. S. P. (pomegranate bark). Dose, 30 grains (2 Gm.).

Fluidextractum granati, U. S. P. (fluid-extract of pomegranate). Dose, 30 minims (2 c.c.).

Pelletierinae tannas, U. S. P. (pelletierine tannate). Dose, 4 grains (0.25 Gm.).

PHYSIOLOGICAL ACTION AND THERAPEUTICS.—Pomegranate is a powerful astringent, and a decoction, flavored with aromatics, has been used in **pharyngitis** and as an injection in **urethritis**. Pelletierine acts like curare. Even full medicinal doses may cause general muscular relaxation, frequently giddiness, confusion and uncertain vision and occasionally nausea and vomiting. If the patient remains quiet after taking the drug, these unpleasant effects are often prevented. It may also cause nausea and vomiting.

Against **tape-worms**, in tropical countries the powdered bark is used in doses of ½ to 1½ drams. The decoction (made by soaking 2 ounces of the bark in 2 pints of water for 24 hours, then boiling down to 1 pint) is a nauseous dose, but generally efficacious; a wineglassful of this decoction is taken every hour until the whole pint is taken. Generally

purging and vomiting follow, but should purging not occur, castor oil or other good purge should be used to expel the worm. A previous fast of 12 hours is necessary. Pelletierine tannate is given in doses of 3 to 8 grains in 1 ounce of water, or in syrup or capsule, followed in 2 hours by a purge. W.

PEMPHIGUS.—Many bullous eruptions have been found to be distinct entities, differing in their symptoms, course, and etiology, so that the term pemphigus is now applied to a comparatively restricted group. It may be interesting to mention briefly the bullous eruptions formerly included in the pemphigus group:—

Pemphigus congenitalis is a rare bullous affection generally becoming apparent late in the first month of life, although it may be present at birth. The bullæ usually develop as a result of traumatism to the skin, as scratching, rubbing, rough handling, or pressure. It is sometimes known as traumatic pemphigus, but more commonly as "epidermolysis bullosa hereditaria."

Pemphigus contagiosus is a purely local bullous affection, and is spread by contact. It is a bullous form of impetigo due to inoculation, through an abraded skin, of a streptococcus.

Pemphigus gravidarum is a bullous eruption occurring occasionally in pregnant women, but more often during the puerperium. It is included by Dühring as a form of "dermatitis herpetiformis."

Pemphigus hystericus is a rare bullous eruption associated with a functionally disturbed nervous system and hysterical symptoms. In many cases the bullæ are artificially produced by cantharides or other blistering methods.

Pemphigus leprosus is a cutaneous lesion of leprosy, in which the bullæ are secondary to the invasion of the nerves supplying the affected areas by lepra bacilli.

Pemphigus neonatorum is a bullous eruption of newborn infants due to infection. (See NEWBORN, DISEASES OF.)

Pemphigus syphiliticus is a bullous syphilide, found usually on the palms and soles of syphilitic infants, and is almost always associated with other stigmata of hereditary syphilis.

True pemphigus may be divided into two general varieties, acute and chronic, and the latter may be subdivided into *Pemphigus foliaceus* (Cazenave) and *Pemphigus vegetans* (Neumann). It will be seen that while the characteristic feature of real pemphigus is the bleb, it must, as Schalek remarks, be elementary, begin as such, and not be due to secondary changes of other skin lesions; it must not be a local condition, but the manifestation of a grave internal disorder having a chronic course with exacerbations and remissions, and causing profound systemic depression and frequently death.

ACUTE PEMPHIGUS.—This is a type of acute bullous eruption accompanied by severe constitutional symptoms of a septicemic nature and is usually fatal. This form has usually been observed in adults, principally butchers or those who handled animal products such as hides. The eruption in these cases is more or less widely disseminated, invading the mucous membrane and the skin. There is usually a definite history of traumatism—a scratch on a butcher, a poisoned thumb in a tanner, a sore following a dog-bite, etc. (Macleod). After a period of incubation which may be several months, the bullous eruption appears, either suddenly or after certain prodromata—chilliness, malaise, etc., and either upon apparently healthy skin or upon erythematous patches. Associated with the eruption are constitutional symptoms of a septicemic type, varying according to the extent of the eruption, which ordinarily terminate fatally.

The etiological factor is believed to be a specific microbe of animal origin, which enters the system through a break in the skin-surface. As the microbes multiply they cause the septicemic symptoms, and the eruptions of bullæ, either locally from autoinoculation or by being transported in the blood-stream. Bulloch and also Demme have isolated a diplococcus which is believed to be the pathogenic agent.

CHRONIC PEMPHIGUS.—This is considered the classical type of the disease. In this form the bullæ appear as vesicles, and gradually increase in size until they become as large as a hen's egg. As a rule they form on apparently healthy skin,

and come out regularly, or in crops. A slight febrile disturbance with malaise may precede the eruption, or prodromata may be absent. Subjective symptoms (burning and itching) are usually lacking. The blebs last from three to ten days. A succession of crops may follow for weeks or months and then gradually subside. The bullæ contain at first clear serum, which soon becomes cloudy and purulent, and surrounded by an inflammatory halo. The blebs may become the seat of hemorrhage or gangrene. Not infrequently the mucous membranes of the mouth, stomach, and nose may be invaded.

The etiological factor of this affection is supposed to be a toxin, the nature of which is unknown. Various micro-organisms have been found in the bullæ.

Pemphigus Foliaceus.—In this variety of chronic pemphigus the bullæ abort before maturity and either become patches of exfoliating epidermis or persist as flaccid blebs which rupture and leave shiny, moist patches, lacking more or less epidermis, or the blebs may be covered with crusts. The mucous membranes may be invaded, and the nails and hair may be lost. The general health soon becomes impaired and the kidneys and other internal organs involved, the patient becoming weaker, and collapse preceding death. If recovery takes place, as it may in rare cases, remissions are the rule. The etiology of the affection is unknown, but an excess of eosinophile leucocytes are present in the blebs and in the blood, from which Leredde concluded that it was a toxic disease, chiefly involving the bone-marrow and other blood-forming organs, and that the poison carried by the blood-stream caused the eruption on the skin. A microbic origin has also been suggested.

Pemphigus Vegetans.—In this variety of chronic pemphigus the bullæ in certain situations, as in the axillæ, about the genitalia and sides of the mouth, are succeeded, after rupture, by vegetating growths arising from the denuded base, and coalescing to form fungous masses. The eruption has a tendency to become serpiginous, and to ulcerate. Where the skin is moist, the fungous masses appear. Severe constitutional symptoms accompany the eruption, with a fatal issue in

most cases. In milder cases death may be delayed for years, and be preceded by remissions. The disease is considered by most authorities to be caused by bacteria, a systemic toxic infection resulting, the fungating masses being probably due to secondary staphylococcic inoculation of the lesions. This latter seems probable, since the use of antiseptics cause the disappearance of the vegetations. Among the microbes found are a pseudodiphtheritic bacillus pathogenic to guinea-pigs (Waelsh), streptococci (MacCormac), and *B. pyocyaneus* (Winfield and Pernet). Jamieson and Welsh have, however, repeatedly found the blebs to be sterile and streptococci absent; degenerative changes in the spinal cord, cerebral cortex, and sympathetic ganglia in a case under their care suggested bacterial origin.

TREATMENT.—**Arsenic**, beginning with small doses and increased until the physiological limit is reached, is perhaps the most valuable internal remedy. **Quinine** in full doses, **iron**, **strychnine**, and **codliver oil** are also of value. **Hygienic measures, nutritious food, and rest** for the mind and body are all important.

Local treatment should aim to heal the abraded surfaces and to relieve the subjective symptoms. The **blebs** should be **evacuated**, and **soothing ointments, lotions or dusting powders** applied. **Calamine lotion** and **bran and starch baths** are valuable. In grave cases the **continuous warm bath** may be used, day and night, for months.

W.

PEMPHIGUS CONTAGIOSUS.

—This disease, more commonly known as *Pyosis mansonii*, is a form of bullous pyosis affecting the axillary, inguinal, and scrotocrural regions. It is quite prevalent in Burma (Castor) and in the low-lying districts of the tropics. It has no connection with true pemphigus, but is closely related to impetigo, of which it may be considered a variety. Although the eruption generally attacks the regions named, it often extends to the abdomen, back, and limbs, but rarely the face. It is extremely contagious, and is more marked in those who perspire freely and suffer from prickly heat. The eruption occurs as flattened, rounded vesicles which rapidly en-

large to the size of a small pea. More rarely, very large, flabby, pemphigoid bullæ may be seen. The contents of the bullæ, at first transparent, soon become turbid. The vesicles are frequently surrounded by a pinkish or reddish inflammatory halo. The vesicles collapse on puncture. The general health is rarely affected. The eruption may be very persistent and may be followed by a crop of boils. A journey to the hills or to a cool climate causes spontaneous disappearance of the eruption.

The etiology is not certain. Manson found a diplococcus. Leishmania-like bodies have been observed by others. Clayton, Castellani, and Chalmers have found cocci generally arranged in pairs, and having often a gonococcus-like shape, which are Gram-positive and in cultures present all the characteristics of *Staphylococcus pyogenes aureus* and *albus*.

The disease resembles chicken-pox and impetigo contagiosa. From the former it is differentiated by the absence of fever and the location of the vesicles; from the latter by the absence of crusts.

TREATMENT.—**Antiseptics** are most useful. The eruption should be disinfected twice daily with antiseptic solutions, such as **mercury bichloride** (1:2000), **carbolic acid** (2:100), **potassium permanganate** 1:4000), **hydrogen dioxide** (10:100), or **lysol** (2 to 5:100). The **vesicles** are **evacuated**, the **region** again **washed** with the **disinfectant**, and an **antiseptic powder** freely dusted on the surface. After the eruption has healed, **Condy's fluid** or other disinfectant should be used **in the bath** to prevent relapse. W.

PENIS AND TESTICLES, DISEASES AND INJURIES OF.—DISEASES OF THE PENIS.—ANOMALIES.—Anomalies of the penis are so extremely rare that they possess but little clinical significance. Such patients are often mentally deficient and so afflicted with other extensive malformations and deformities that they rarely survive for any great length of time.

Absence of the Penis.—This is the rarest of anomalies of the penis, and,

with the exception of a case reported by Demarquay, practically unknown except in very young children. In Vinogradoff's case, a boy aged 7, although the penis was absent, the scrotum and testicles were normal. The urethra may open into the rectum, by the margin of the external sphincter, or in the perineum. It is highly probable that some of the cases of absence of the organ are really instances of rudimentary or concealed penis.

Concealed Penis.—A few cases have been reported in which the penis was small, undeveloped, and concealed beneath the skin near its normal situation. The penis may be concealed in cases of elephantiasis of the scrotum or large hernia. Urine was passed through a fistulous opening in several cases; in others no opening could be found, and retention of urine followed.

TREATMENT.—In every case of apparent absence the organ should be carefully searched for, freed by incisions, and by a plastic operation covered by skin taken from the neighboring parts.

Rudimentary Development.—Rudimentary penis, especially when complicated with cryptorchism or other abnormalities, is not uncommon. Men of middle age with genitalia no more developed than children of 5 or 6 years are frequently seen. Many of these cases, however, are capable of marital relations, and have successfully impregnated women, although impotence is the rule.

TREATMENT.—In many instances but little can be done for the relief of this condition. When seen in early life, preputial adhesion or a tight phimosis should be relieved. In the young adult a suction apparatus has

been recommended and employed with considerable success. A bell-jar fitting tight around the root of the penis is exhausted by a rubber bulb, thus causing congestion and distention of the erectile tissue. Such treatment should be carried out over a long period.

Hypertrophy of the Penis.—The size of the penis bears no relation to the size of the individual. In imbeciles and dwarfs it may be enormous, while in the well developed it may be quite small. Hypertrophy of the penis may render coitus impossible, and may be a source of danger by predisposing the patient to abrasions and fissures through which he may become inoculated with venereal poison.

Double Penis.—This anomaly has been noted in several authentic instances. The two organs are usually placed side by side, and other evidences of monstrosity generally exist (supernumerary limb). In several of the cases the function of both organs was perfect, as regards urination, capability of erection, and seminal emission.

Torsion of the Penis.—Twisting of the penis on its long axis so that the frenum is uppermost is most uncommon. This condition is often accompanied by either epispadias or hypospadias. Urination and ejaculation of semen are, as a rule, not interfered with; hence no treatment is required.

Adherent Penis.—Through nearly its entire length the penis may be adherent to the scrotum,—of course, interfering with its function.

TREATMENT.—Such a deformity should be operated upon as soon as discovered in order to prevent stunting or incurvation of the organ. The

membranous septum should be divided along its entire length, and the raw surface remaining closed by sutures or by a plastic operation.

ANOMALIES OF THE PREPUCE.—The prepuce may be absent, redundant, or incompletely developed. Absence of the foreskin calls for no treatment, nor does incomplete development unless complicated by phimosis or an irritated or inflamed glans penis.

Adherent prepuce is often responsible for many reflex phenomena of a convulsive or paralytic type and stunted growth of the penis. Its treatment can be readily carried out, in most instances, by relieving the phimosis either by performing **circumcision** or by **stretching the preputial orifice**. The raw surfaces resulting from the latter procedure should be smeared with an ointment composed of a dram (4 Gm.) of **boric acid** to the ounce (30 Gm.) of **carbolyzed petrolatum**. The glans penis should be washed daily with **mild antiseptic solutions** and the ointment reapplied.

As cellulitis followed by death has resulted from the above stripping process, at least ordinary **antiseptic precautions** should be observed.

Occlusion or obliteration of the preputial orifice may not be detected immediately after birth, but the appearance of a tumor at the end of the penis due to the accumulation of urine will soon call attention to the trouble. The treatment of this condition is **circumcision**.

Short Frenum.—This congenital deformity occasionally interferes with complete erection, turning the orifice of the meatus down, and not only preventing ejaculation in the proper

direction, but rendering coitus painful or impossible.

TREATMENT.—The **base of the frenum** should be **divided** by a narrow bistoury, and the **prepuce kept retracted** until healing is complete.

PHIMOSIS.—A preternatural elongation of the prepuce with a contracted orifice rendering it impossible to uncover the glans penis is termed phimosis. The preputial orifice may be so small that a probe cannot be made to pass ("pin-point" orifice).

Varieties.—1. Congenital (always permanent). 2. Acquired: inflammatory (usually temporary); cicatricial (always permanent).

CONGENITAL.—The prepuce begins as a fold of tissue about the third month of fetal life; as it grows forward the inner surface of the foreskin becomes adherent to the glans penis. During the first year of life the prepuce generally becomes loosened; should this not occur a true phimosis results.

ACQUIRED.—The acquired may be either inflammatory or cicatricial. The inflammatory—balanoposthitis—usually occurs as a result of various forms of ulceration about the glans and prepuce. Cicatricial contraction results from the healing of ulcers, injuries, and bad circumcisions—the mucous membrane being left too long, thus permitting the scar to slip in front of the corona glandis.

Symptoms.—Moderate phimosis may exist without giving rise to symptoms. However, as a result of the decomposition of the retained smegma and urine and obstruction to the flow of urine, symptoms may develop which are exceedingly distressing and may permanently impair the general health. In children there are

symptoms which often simulate vesical calculus: balanitis, heat, itching, pain at the head of the penis, frequent erections, pain on urination, frequency of micturition, dysuria, or incontinence. Under the remote effects may be considered malnutrition, choreic movements, paralysis, convulsions, prolapse of the rectum, hernia, atony of the bladder, the latter conditions being most frequently seen when there is marked contraction of the preputial orifice requiring severe straining efforts to be made during urination. In older children the condition is apt to give rise to priapism, and is undoubtedly the cause of masturbation and often an arrest of development of the penis.

After puberty and later, functional sexual troubles begin: erections occasion intense pain, the repeated attacks of balanoposthitis reflexly predispose to nocturnal emissions, and coitus is painful or impossible.

When phimosis is unrelieved, the irritation of chronic balanoposthitis is the frequent cause of fissures, vegetations and adhesions; in later life, and, in consequence of it, cancer is liable to occur.

It is not uncommon in long-standing cases of phimosis to find one or more calculi beneath the prepuce due to decomposition of the urinary salts. These calculi may be very small, but, may, however, weigh several ounces.

Treatment.—*Permanent phimosis*, whether congenital or acquired, should always be treated by operation (**circumcision**). In the majority of instances congenital phimosis is spontaneously relieved. If the epithelial separation is not complete at birth, it may be quickly accomplished by the flat end of a probe, the raw surface

left being covered with **carbolyzed oxide of zinc ointment** to prevent adhesions.

For *temporary phimosis* following inflammations and ulcerations subpreputial **injections of Castile soap and hot water** with a flat-nozzled syringe should be made twice daily, followed by the use of a **lead-water and laudanum solution** to which $\frac{1}{2}$ dram (2 Gm.) of **carbolic acid** has been added to every 6 ounces (180 Gm.). During the day the entire organ should be kept wet with **lead-water and laudanum**.

CIRCUMCISION.—Operation for the removal of the prepuce is indicated in chronic balanoposthitis with or without adhesions; certain cases of paraphimosis; to prevent masturbation; when the sexual orgasm is too early induced; to prevent gangrene of the glans penis consecutive to concealed ulceration; tuberculosis, and epithelioma.

The usual antiseptic precautions are to be observed. With a pair of Ricord's phimosis forceps the prepuce is grasped just at the corona glandis, parallel to its obliquity, and the prepuce is drawn in front of the glans as the forceps are locked. With a sharp-pointed straight bistoury the prepuce is divided with a sawing motion through the fenestra of the forceps. The skin now retracts behind the corona, exposing the inner or mucous layer of the prepuce still covering the glans. With a fine pair of scissors this is now divided in the median line to the corona. The two flaps remaining are then cut off close to the edge of the corona, leaving just sufficient tissue to hold a stitch. This will prevent the scar from slipping in front of the corona, thus causing a

return of the phimosis. The frenal artery is now twisted or ligated with fine catgut, and the wound closed with fine-catgut sutures. The first suture should be introduced at the frenum, the second at the dorsum, and two or three at intervening points on both sides; care should be taken that the raw surfaces be accurately approximated. A **gauze bandage** wet with a 25 per cent. **boroglyceride solution** should be applied as a dressing. The bandage should be removed daily or every other day and the parts irrigated with 1:5000 **nitrate of silver solution** and the **boroglyceride** dressing be applied.

Sutures are almost always unnecessary in circumcision; they add to the length and pain of the operation, make the subject more prone to infection, and often leave stitch scars. The writer avoids them entirely by the following method: After the prepuce and the mucous membrane have been cut away in the usual manner, the skin and the mucous membrane can be made to adhere together very satisfactorily by applying several hemostats around the cut surface, placing them on the skin from before backward in such a manner as to grasp the mucous membrane and the skin with edges approximating between the jaws of the hemostat for a third of an inch, and compressing the jaws tightly. The fenestrations of the blades press the tissues together in corrugated ridges, and they will remain adherent, when, after a few minutes, the hemostats are removed. No sloughing occurs at the point of compression. The usual circular dressing is applied, leaving the meatus free. This dressing is changed every 24 to 36 hours. Healing is usually by first intention. In a very small percentage of cases a bleeding vessel may have to be ligated, but this occurrence is very rare and generally compression con-

trols the hemorrhage. S. Meredith Strong (*Amer. Jour. Surg.*, March, 1914).

When the penis is large the operation may be done without the aid of forceps. A grooved director is introduced between the glans and the prepuce exactly in the median line, and on it both layers of the prepuce are divided at one time by scissors to the corona. An assistant with dissecting forceps makes slight traction upon the triangular flaps remaining, and with curved scissors the skin and mucous membrane are cut off close to the line of the corona as above described.

Circumcision, as is well known, is a prophylactic ritual procedure among the Jews. It is not infrequently a source of infection, however, though its prophylactic value is undoubted.

Accidents and infections are not uncommon in the performance of ritual circumcision. One of these accidents is the amputation of a small slice of tissue at the tip of the glans penis, and results from failure to employ the circumcision shield. A more serious injury is complete severing of the corpus spongiosum and urethra and partial severing of the corpora cavernosa. Another condition met with is the persistence of preputial adhesions. F. Bierhof (*N. Y. Med. Jour.*, May 18, 1912).

Comparative occurrence of venereal and non-venereal affections of the genitals among the non-circumcised (Christian) and circumcised (Jews and Mohammedans) classes of Moscow: In 7065 uncircumcised persons there occurred: Non-venereal affections of the genitals, 1108 cases; gonorrhea and its complications, 1108 cases; hard and soft chancres, 1773 cases; syphilis with site of the initial lesion undetermined, 895 cases. In 412 circumcised subjects the corresponding figures were 21, 299, 70, and 22. This gives the following per-

centages for the 2 classes: Non-venereal diseases of the genitals, uncircumcised, 15.68 per cent.; circumcised, 5.09 per cent. Venereal diseases of the genitals, uncircumcised, 95 per cent.; circumcised, 53.44 per cent. Pawloff (*Dermat. Woch.*, Feb. 17, 1912).

PARAPHIMOSIS.—Inability to draw forward a retracted prepuce from behind the corona glandis may be caused by gonorrheal balanoposthitis, chancre, chancroids, violent coitus, retraction of a tight prepuce, and any lesion of the glans or prepuce attending by swelling.

Adrenalin found useful in paraphimosis. The swollen and congested mucous membrane and glans become much smaller under gentle pressure after being well moistened with it, and reduction is then accomplished. M. B. (*Lancet*, Mar. 6, 1926).

Symptoms.—As a result of the mechanical constriction by the preputial orifice, the glans penis rapidly swells, and becomes red and tense. Over and behind the coronary sulcus is a brawny swelling, which represents the mucous layer of the prepuce. Behind this another deep groove is seen, which corresponds to the preputial orifice, the seat of constriction. If left untreated, gangrene may result; or it may remain chronic, the retracted tissue becoming inelastic and indurated.

Treatment.—When the paraphimosis is of sudden development and not dependent upon edema consecutive to ulcerative lesions, **reduction** should be attempted immediately. The organ should be rendered bloodless either by gentle pressure or by the application of a small finger bandage. The parts are then greased well with sweet oil, the index and middle fingers of each hand are crossed behind

the glans penis, and with the thumbs attempt should be made to force the glans penis through the swollen tissue. When reduction is possible, the foreskin will slip forward with a characteristic snap. Failing in this, the **preputial orifice is to be divided** in the second groove on the dorsum, with a curved, sharp-pointed bistoury, cutting from within outward. **Hot compresses** should be applied for several hours to restore the circulation and favor the absorption of the edema.

When paraphimosis is consecutive to ulceration and in no danger of causing gangrene, **hot compresses** or **lead-water** should be applied and at the same time the original lesion should be treated. These cases usually reduce spontaneously. If not, they should be treated as above described. Should the brawny edema of the reduced tissues persist for several weeks or months, **circumcision** is to be recommended.

INJURIES OF THE PENIS.—

Contusion.—Severe contusions of the penis occasion so intense an ecchymosis and edema as to simulate rapid gangrene. Small circumscribed tumors form, most prominent during erection, and result from the rupture of vessels in the cavernous bodies, forming hematomata. When the urethra is involved, blood will escape from the meatus, and inflammatory phenomena quickly develop.

TREATMENT.—Contusion may be treated by **rest, elevation**, and the application of **hot antiseptic compresses**. If the symptoms are progressive an **incision** should be made under strict antiseptic precautions and the **bleeding vessels ligated**. *Emphysema* is a serious symptom and necessitates free **incisions**, as does the first sign of *sup-*

uration; thorough **drainage** in this instance is essential. *Extensive swelling and discoloration* should not occasion alarm unless there has been rupture of the urethra or the cavernous or spongy bodies.

Incised Wounds.—Incised wounds, when slight, heal quickly when closed early. If, however, they are deep and the erectile tissue is involved, free hemorrhage results, and the possible loss of the power of erection in the part anterior to the wound. When the penis is completely divided hemorrhage may be so serious as to cause death unless quickly controlled.

TREATMENT.—All *hemorrhage* is to be controlled by **ligature**, the *venous oozing* is checked by the simple **apposition of the cut surfaces**. If it cannot be so controlled, a **hard-rubber catheter** may be introduced into the **urethra** and a **tight roller bandage** applied.

Such **remedies** as have a tendency to **prevent erections** should be administered internally. No matter how extensive the wound, an effort should always be made to **suture** together a divided penis. Cicatrices left after healing may distort the penis and render erections imperfect and painful.

When the urethra is divided it should be **sutured**, and a **catheter introduced** through the urethra into the **bladder** to prevent the formation of a urinary fistula; it should be removed at the end of the seventh day.

Punctured Wounds.—Like punctured wounds elsewhere in the body, infection is likely, and a severe inflammation usually results.

TREATMENT.—Whenever possible, all punctured wounds should be **converted into incised wounds** in order

to prevent infection and permit of **drainage** from the bottom.

Contused and Lacerated Wounds.

—These wounds are dangerous only when the tissues are devitalized to a great extent or the urethra involved. When extensive they are liable to be followed by loss of erectile power or distortion of the penis.

TREATMENT.—These wounds require treatment that will control the resulting inflammation. *When the urethra is involved, a catheter should be passed through into the bladder and maintained in place for a week or ten days.* Occasionally it may be impossible to pass an instrument from before backward. Under such circumstances it will be necessary to **open the urethra behind the injury and pass the catheter from behind forward.**

Gunshot Wounds.—Gunshot wounds simulate contused and lacerated wounds and are subject to the same complications. The **bullet should always be removed.**

Fracture of the Penis.—This injury may happen during coitus, "missing the mark," the organ striking the outer wall of the vulva or the pelvic bone, and from traumatism calculated to "break" a painful chordee. The injury consists in a laceration of the corpora cavernosa, and is followed by an extensive hemorrhage into the subcutaneous tissues and great swelling. The erection immediately disappears, and the part anterior to the injury is unnaturally movable. When the urethra is involved there is an escape of blood from the meatus, and infection is extremely likely to occur. After such an injury the power of erection in the part anterior to the injury is usually lost; this may inter-

fere with coitus and cause permanent impotence.

TREATMENT.—Fracture of the penis may be treated either conservatively or radically. The injured organ may be kept wet with **lead-water and laudanum solution** and held firmly pressed against the abdominal wall by means of a **bandage**. The penis may be **incised, the clots turned out, the bleeding vessels ligated, and the rent in the capsule closed with sutures.** A permanent catheter should be introduced and the entire penis covered with an **anti-septic dressing** retained by a firm **roller bandage**. The catheter should be removed at the end of forty-eight hours and a new dressing applied. *Erections must be prevented* by the free use of **bromide of sodium or potassium** and by **keeping the bowels regular.**

Strangulation of the Penis.—This condition has been frequently noted in children because of the habit of tying strings or bands around the penis to prevent incontinence. Oftentimes a band or ring is slipped on the penis for the purpose of maintaining or increasing erections. Imperfect erections, traumatic strictures, and urethral fistulae may follow; or, in rare instances, gangrene.

TREATMENT.—The **removal of the constricting body** is usually followed by a return to normal conditions. Ulceration may cause a circular scar which will interfere with erections in the distal part.

Dislocation of the Penis.—This injury results from a severe blow to the penis when in a flaccid state, tearing the subcutaneous cellular tissue at its root, forcing the organ to become incarcerated in the subcu-

taneous tissue of the abdomen, scrotum, perineum, or thigh. The mucous layer of the prepuce, which should prevent this accident, usually gives way along the line of the coronary sulcus. The urethra is occasionally ruptured in the perineum.

There are intense pain, extensive subcutaneous hemorrhage, and also bleeding from the meatus. Occasionally there are urinary extravasation and an abnormal position of the root of the penis.

TREATMENT.—The penis should be returned to its normal position by **traction** when possible, or by means of a **hook introduced into the meatus**. Failing in this it is proper to make **incisions** to permit of sufficient **manipulation** that the organ can be reduced. **Extravasations of urine** should be **opened and drained**, and an **external urethrotomy** or **perineal section** performed. Unless reduced early, adhesions may form which are at times difficult to remove.

INFLAMMATORY AFFECTIONS OF THE PENIS.—**Penitis.**—An inflammation of the penis which may be acute and due to gonorrheal folliculitis, erysipelas, rupture of the urethra with urinary extravasation, and wounds; or chronic, due either to the rheumatic or gouty diathesis or to syphilis. It is also ascribed to old areas of blood-extravasation which have undergone organization.

When superficial, all the signs of inflammation are present associated with a rapid, inflammatory edema. In the circumscribed variety the inflammatory symptoms are local and followed by the formation of a tumor, which finally softens, indicating pus formation. The diffuse form is rapidly followed by gangrene.

The chronic variety is characterized by slow-growing, painless areas of induration scattered through the cavernous bodies. The erect penis is bent at the seat of induration, and erections are usually incomplete in that part anterior to the node.

TREATMENT.—In the acute diffuse variety early **free** and **multiple incisions** are necessary to prevent gangrene; **drainage** should be provided for, and **antisepsis** maintained. *Where gangrene has already developed*, the treatment should be that appropriate for gangrene in other parts of the body. *When spreading slowly*, **hot antiseptic fomentations** should be applied until the slough separates, and the remaining simple **ulcer treated** on general principles. *In the rapid-spreading form of gangrene* the sloughs should be **cut away**, and the raw surface left touched with the **thermocautery**. **Circumscribed abscesses** of the cavernous bodies should be **opened early** and thoroughly **drained**. The function of the penis may be somewhat interfered with after healing.

In the *chronic form* of the trouble little can be done. **Iodide of potassium**, **arsenic**, subcutaneous use of **fibrolysin** and other remedies indicated in rheumatism and gout should be administered internally, while locally **mercurial** or **ichthyol ointment** should be applied. Occasionally **pressure with a fine-rubber bandage** will bring about a cure. Occasionally it is possible to remove these localized indurations by **operation**, and thus restore the normal erection. **Strict antisepsis** must be maintained.

Gummata of Penis.—This condition is rare, and is usually situated between the cavernous bodies.

TREATMENT.—Same as for gum-mata elsewhere.

Lymphangitis.—Lymphangitis is always secondary to peripheral inflammation and may be simple or venereal in origin. The vessels feel like fine wires beneath the skin and usually lead to the nearest lymph-glands, which will be found enlarged. Occasionally small nodules form which may soften, break down, and ulcerate, leaving small fistulæ, which may persist for a long time. The condition must be distinguished from phlebitis by the smallness of the vessels; the fact that they are not in the median line; the cord of induration extends outward, at the root of the penis, toward a group of enlarged glands, instead of disappearing beneath the pubic arch; and the much lessened edema.

TREATMENT.—**Rest, elevation,** and the application of **evaporating lotions.** When they are dilated without inflammation, **pressure** or the use of **mercurial ointment** may cause them to disappear; otherwise, **excision** is required to bring about a cure.

Phlebitis.—This is a rather uncommon condition and is usually secondary to diseases of the penis or urethra. There are usually considerable pain and edema, and quite a large indurated cord is felt along the dorsum of the penis exactly in the median line. Occasionally suppuration takes place.

TREATMENT.—**Rest, elevation,** and the use of **evaporating lotions** or **mercurial ointment** are usually sufficient.

Varicose Veins.—Varicose conditions of the veins is not uncommon and is of but little clinical significance, although they may occasionally be accompanied by a loss of power of

erection. When large enough to prevent coitus, they may be **ligated** or **excised.**

Balanitis and Posthitis.—Balanitis is an inflammation of the mucous surface of the glans penis, and posthitis an inflammation of the mucous layer of the prepuce. As the two surfaces are usually attacked simultaneously the term balanoposthitis is used.

The predisposing cause is a redundant or phimotic foreskin. Because of the retained smegma and urine, the two mucous surfaces are kept constantly moist; they become more or less macerated, offering conditions most favorable for the development of micro-organisms. Diabetes is also said to be a predisposing cause. The exciting causes are irritations, abrasions, contact with endometrial discharges, and chancre and chancroid, gonorrhea and diphtheria.

SYMPTOMS.—In the mild forms there is usually some burning and itching, the mucous membrane is red, somewhat thickened, and a serosanguinous pus escapes from beneath the foreskin or covers the surfaces as a milky secretion from which a very offensive odor is emitted. When the inflammation is more intense, superficial erosions and ulcers are seen about the corona. Croupous and diphtheritic varieties of inflammations have been observed, the mucous layers being covered with a membranous coating; it is closely adherent, and the attempt to strip it off is followed by hemorrhage. Among the complications are phimosis, paraphimosis, lymphangitis, and gangrene.

TREATMENT.—Balanoposthitis may be promptly relieved by **cleanliness.** The **prepuce** should be gently re-

tracted, the parts washed freely with Castile soap and warm water twice daily, carefully dried, and dusted with equal parts of bismuth, boric acid, and calomel. It is usually a good plan to interpose a piece of gauze or lint, so that the two inflamed mucous surfaces will not come in contact with each other. Some surgeons prefer lotions or washes. A small piece of cotton is spread out over the surface of the glans penis and moistened with a solution of lead-water and laudanum, or with such a combination as the following:—

R *Zinci sulph.* gr. iij (0.2 Gm.).
Plumbi acet. gr. vj (0.4 Gm.).
Morph. sulph. gr. vij (0.45 Gm.).
Aquæ fʒij (60 c.c.).

Then the prepuce is pulled forward over the glans. In the presence of *erosion or ulcerations* the entire mucous surface should be painted over with a solution of **nitrate of silver** (gr. xx to fʒj—1.3 Gm. to 30 c.c.).

When complicated by *phimosis*, the inflammatory edema must be counteracted by the frequent use of **hot compresses, lead-water and laudanum, and subpreputial injections**. As soon as the glans can be exposed, the ordinary local treatment as described above is indicated.

In cases of *chronic balanoposthitis*, or when there are frequent acute attacks, **circumcision** is to be recommended.

Herpes Progenitalis.—A condition characterized by the sudden appearance of one or more vesicles on the balanopreputial mucous membrane, surrounded with an erythematous area, and attended by an itching, burning pain.

The predisposing causes are catarrhal diathesis, neuroses, gout, rheu-

matism, and phimosis, and the exciting one is any irritation of the balanopreputial mucous membrane.

SYMPTOMS.—Herpes usually appears suddenly as a cluster of vesicles surrounded by a red areola. These vesicles, at first containing a clear serum, which later becomes cloudy, finally dry up and scab over, leaving a bright-red spot. Occasionally the vesicles rupture, and a true ulcer results, which may become of large size when secondarily infected. Sometimes the lesions are accompanied by a slight burning pain; at other times the pain is intense and neuralgic in character. The pain may precede the development of the vesicles. The disease shows a marked tendency to recur and may occasion a polyganglionic, painless bubo.

DIAGNOSIS.—Herpes must be distinguished from chancre, chancroid, and mucous patches. The chancre usually appears between the tenth and forty-second days; it is single; painless; begins as an erosion, papule, or tubercle, and is indurated, elevated above the surface of the surrounding tissue, shows little or no secretion, and often disappears spontaneously. Dark-stage examination of the secretion would show the *Spirochæta pallida*. Chancroid appears within five days; it may be single, but is usually multiple from autoinoculation; begins as a pustule, always ulcerates, is punched out, secretes profusely, and is often painful. The mucous patch is always accompanied by other manifestations of syphilis.

TREATMENT.—The basis of all treatment is **cleanliness**. The parts should be frequently washed with warm water, each vesicle touched with **nitrate of silver** (gr. xx to fʒj—1.3 Gm.

to 30 c.c.), and the application of such **powders** and **lotions** as are applicable for balanoposthitis. *When the pain is neuralgic*, a 4 per cent. solution of **cocaine** or a dram (4 Gm.) of **chloral hydrate** to the ounce (30 c.c.) of water may be applied. Constitutional treatment should always be directed to the correction of any existing dyscrasia. In *recurrent herpes* **circumcision** is the only means that will bring about a permanent cure.

TUBERCULOSIS OF THE PENIS.—Tuberculosis of the penis is an extremely rare condition. It may be periurethral, balanopreputial, and urethral. The disease, as in other parts of the body, is characterized by the formation of ragged, irregular, undermined ulcers, of very slow growth, and exhibiting little or no tendency to heal. The inguinal glands are often involved, and occasionally undergo caseous changes.

Infection by the tubercle bacillus in the male genital apparatus occurs first in the prostate or seminal vesicle and not in the epididymis as others affirm. This was established by necropsy findings. Quinby (Jour. Amer. Med. Assoc., Nov. 30, 1918).

Treatment.—When seen early, the ulcers should be **curetted**, touched with pure **phenol**, and dressed antiseptically with **iodoform**. Internally, remedies should be administered to correct the existing diathesis. In later stages **amputation** of the organ may be necessary.

TUMORS OF THE PENIS.—Tumors of the penis may be either benign or malignant, solid or cystic.

The benign tumors include cysts (mucous, sebaceous, or hemorrhagic), adenoma, fibroma, horns, elephantiasis, papillomata, and vascular growths.

The malignant tumors include **sarcoma**, **carcinoma**, and **epithelioma**. With the exception of sebaceous tumors, cysts are rare; the former may occur in any region where sebaceous glands are present.

Adenoma and **fibroma** are exceedingly rare. Guitéras and Beck each reported a case. They coincide completely with similar growths in other parts.

Horns springing from the glans have been reported by Brinton and others. They have the appearance of a nail, and when dry are smooth and polished.

Elephantiasis usually involves the penis and scrotum, which organs may attain large size. It is but rarely seen in temperate latitudes. It may result from wounds and diseases which obstruct the lymph-channels.

The treatment of this condition is unsatisfactory. Large doses of **potassium iodide** may be tried. **Circumcision** may be done so as to remove as much of the thickened skin as possible.

Vascular growths are occasionally found along the dorsal vein and include angiomas and nevi.

The treatment of benign tumors of the penis is that appropriate for like conditions in other parts of the body: **removal** when increasing in size or interfering with function.

Case of marked *angioneurotic edema* of the penis and scrotum developing in 12 hours in a man of 34 years. He had had an attack of angioneurotic edema of the tongue and pharynx about 3 months before. No cause was found. Recovery set in 4 hours after intramuscular injection of 10 minims (0.6 c.c.) of 1:1000 **epinephrin** solution, the edema gradually disappearing. W. J. Ezickson (Jour. Amer. Med. Assoc., Aug. 21, 1926).

Papillomata, venereal warts, or vegetations represent an overgrowth of the papillæ of the balanopreputial mucous membrane. They are usually due to repeated attacks of balanoposthitis superinduced by a redundant or phimotic prepuce in young men who are uncleanly. They are in no sense venereal in origin.

SYMPTOMS.—Venereal warts appear as large or confluent, moist or dry, pedunculous or sessile papillary overgrowths, usually springing from the coronary sulcus, the glans penis, or the inner layer of the prepuce. The confluent warts often assume the shape of a cauliflower. They grow rapidly, are exceedingly vascular, and often attain large size.

A diagnosis must be made from syphilitic condylomata and epithelioma. Syphilitic condylomata are usually associated with other evidences of syphilis. Epithelioma appears late in life, grows slowly, and is markedly indurated.

TREATMENT.—When small and single, these growths may be destroyed by the frequent application of **carbolic** or **chromic acid**. When large, the penis should be covered with **carbolyzed olive oil** (to protect it from acids), the warts rapidly **cut away with scissors**, going well down into healthy tissue and **cauterizing the base with pure carbolic acid**. A piece of lint or gauze saturated with a 25 per cent. **boroglyceride solution** should be held in place over the raw surfaces by a **bandage**. When large masses are removed it may be necessary to touch the base with the **actual cautery** in order to control the hemorrhage.

Malignant Disease.—With the exception of epithelioma, malignant dis-

ease of the penis is rare, although malignant tumors are much more commonly observed than the benign varieties.

Epithelioma of the penis may exist in the form of an ulcer or cauliflower-like growth. A redundant prepuce or phimosis predisposing to balanoposthitis, with consequent maceration may act as a predisposing cause.

SYMPTOMS.—The disease usually begins as an insignificant ulcer or wart, located most frequently at the preputial orifice or coronary sulcus. It grows slowly and gradually infiltrates the surrounding tissue. The prepuce is finally destroyed, and an offensive, ichorous discharge covers the ulcer, which shows great tendency to bleed on the slightest manipulation. As the disease extends backward, the cavernous bodies become indurated, the skin adherent, and the inguinal lymphatic glands become enlarged and ulcerate.

There is usually no difficulty in making a diagnosis except in the very earliest stages. Under such circumstances a small section might be removed under cocaine and a microscopic examination made.

The prognosis is exceedingly bad unless the growth is removed very early.

TREATMENT.—**Amputation** or **extirpation** of the penis, depending upon the amount of tissue involved, is indicated. The **infected lymphatics** from both groins should always be **removed** at the time of operation in order to prevent recurrence.

AMPUTATION OF THE PENIS.—Amputation of the penis is indicated for the relief of tuberculosis and malignant disease.

The operation may be performed

either by the flap or circular method; the former, however, is to be preferred. Hemorrhage is to be provided against by transfixing the root of the penis with two long pins, and surrounding the organ with an elastic bandage above. These prevent the ligature from prematurely slipping after the organ has been removed. The position and shape of the flaps are to be governed by the length of the disease. Whenever possible, a long anterior flap is to be preferred.

A narrow-bladed knife is introduced between the cavernous and spongy bodies at a point at least one-half inch behind the disease, and a small posterior flap is then cut forward and downward. From this flap the urethra is to be dissected free. A flap of sufficient length is cut from the dorsum and sides of the penis, reflected backward, and the cavernous bodies divided on a level with the line of reflection. The dorsal artery is now tied, the tourniquet removed, and any spurting vessel ligated with fine catgut. The stumps of the cavernous bodies are now covered by suturing together their fibrous envelopes (*tunica albuginea*). The anterior flap is punctured, the urethra drawn through it, slit up, and sutured in place. The two flaps are now united with silkworm-gut sutures. A Nélaton catheter should be tied in place for a week, and then a meatal bougie passed at regular intervals to prevent contraction of the new urethral orifice.

EXTIRPATION OF THE PENIS.—Extirpation of the penis is indicated when malignant disease has extended as far back as the scrotum.

The patient should be placed in the lithotomy position, and the scro-

tum split along the entire length of the raphé. After exposing the anterior layer of the triangular ligament, the spongy body is dissected free and cut off, leaving sufficient to bring out through the perineal incision. With an elevator the crura are dissected from the pubic arch; the incision is prolonged about the penis above, the suspensory ligament divided and the dorsal arteries secured. The stump of the spongy body containing the urethra is now slit up, stitched in the posterior part of the scrotal incision, and the external wound is closed. A catheter should be introduced into the bladder and retained in place for a week.

DISEASES OF THE TESTICLES.

ANOMALIES.—Polyorchism.—

Quite a number of cases have been reported of men who have three, four, or six testicles, but only in a very few authentic cases has the anomaly been verified by *post mortem* or operation. In some of the supposed cases tumors, hernias, and hydroceles have been found.

Anorchism.—Congenital absence of the testicles has been occasionally reported, but on dissection in many of these cases abdominal retention of the organs was noted. The condition is not so uncommon as a unilateral deformity (monorchism). The pelvic portion of the vas and the seminal vesicle are usually present, although the prostate is rudimentary on the corresponding side. In a true case of anorchism the voice does not change, there is no beard, sexual organs are rudimentary, and impotence is the rule. These facts might assist in distinguishing between abdominal retention and ab-

sence, as in the former all the characteristics of the male sex are preserved. It may be sometimes difficult to distinguish absence from atrophy.

TREATMENT.—When the testicles are absent it might be possible to favor the proper development of the individual by injections or ingestion of the **organic extracts (testicular)**.

Synorchism.—Fusion of the testicle has been reported by Baillie and Schurig. In each instance two cords were found.

Hypertrophy of the Testicles.—The size of the testicle bears no relation to the size of the individual. Compensatory hypertrophy is believed to occur when one testicle has been removed. As large organs are more vulnerable than the small, they should be supported by a **suspensory bandage** and the subject cautioned as to the dangers of urethritis.

Atrophy of the Testicles.—True atrophy is always observed in cases of undescended testicle. Even in the normal position one or both may remain rudimentary. They often regain their normal size as the result of physiological activity. Unilateral atrophy frequently follows metastatic inflammations from mumps, pressure from large varicoceles and herniæ. There is no reason to believe that prolonged chastity causes wasting of the organs.

But little can be done for these cases. **Misplacements** should be **corrected**, and **massage** may be tried.

Undescended Testicle.—The testicle may be arrested in any part of its course in its descent from the kidney to the scrotum; when it is retained in the abdomen, the condition is termed *cryptorchidism*. It is sometimes found in the groin. If found in

the perineum or crural canal, the term *ectopia testis* is sometimes applied. The cause of these abnormalities has been variously attributed to small rings, a short cord, peritoneal adhesions, and loss of power or anomalous attachments of the gubernaculum.

Misplaced testicles, as a rule, are undersized, and there is a degeneration and atrophy of the secreting structure. They are often functionless, and sterility results. In some of the reported cases spermatozoa were found. When misplaced outside of the abdomen, the testicles are exceedingly liable to injury, and inflammations and malignant degeneration are common.

DIAGNOSIS.—When the testicle is retained in the inguinal canal it must be distinguished from hernia, which can usually easily be done by noting the absence of the testicle from the scrotum, ovoid shape, irreducibility, and the sickening pain when pressed upon. When situated in the region of the groin, it may be confused with bubo, especially when orchitis is present. The same rules, however, hold good as in the case of hernia.

TREATMENT.—When the organ still remains *in the abdomen*, nothing can be done by surgical intervention; its attachments, being necessarily short, would prevent its being dragged down into the scrotum. When situated *in the inguinal canal*, an effort should be made to bring it into the scrotum by daily **traction**, its return into the canal being prevented by the use of a truss having a very soft pad. If it cannot be drawn down into the scrotum by the sixth year, operation is necessary (**orchidopexy**). The gland is exposed by a free incision, and brought out of the wound, so that the

fibers of the cremaster may be divided transversely. The cord is then gently stretched until the testicle hangs free beyond the external abdominal ring. The scrotum is now invaginated and fastened to the base of the testicle by three catgut or silk sutures. When the invaginated scrotum is drawn out, the anchored testicle is carried into its proper place. The deeper tissues are closed by catgut, and the tissues of the cord are sutured to the pillars of the external ring.

Probably the most satisfactory operation for the relief of this condition is **Bevan's operation**:—

1. Incision.
2. Laying open the inguinal canal.
3. Exposure of peritoneal pouch.
4. Division of cremaster muscle and fascia and transversalis fascia overlying it.
5. Transverse division of the sac (tunica) and ligation of upper end as in hernia operation.
6. Purse-string closure of lower end to form a new tunica vaginalis testis.
7. Gauze dissection of peritoneum from cord, including vas and vessels, leaving these structures alone undivided.
8. Preparation of pocket or pouch and placing the testicle in the scrotum and retaining it there by a purse-string at the base of the scrotum.
9. Closure of the canal by the Bassini method, omitting transplantation of the cord, completes the operation.

In a few cases where sufficient lengthening is not obtained by freeing the cord to place the testicle well down in the scrotum, division of the spermatic vessels is indicated.

In **Walther's operation**, the spermatic cord is mobilized as far up as possible, and the testicle is drawn down and slipped into

the other half of the scrotum through a small slit made for it in the septum. The slit is then sutured on each side of the cord, so that the testicle is held firmly in its new bed by the elastic force of the septum. The cord is left entirely free; the traction from below gradually stretches it. The testicle itself is also left free in its new bed. In 13 patients reexamined after an interval of months to over 9 years, the results were excellent.

In **Thompson's operation**, the incision begins just within the anterior superior spine, and proceeds in a sinuous manner into the scrotum. The first part lies $\frac{1}{2}$ inch above, and parallel with, the outer half of Poupart's ligament. The second part is curved with its convexity directed downward and outward. It begins just above the middle of Poupart's ligament and ends near the pubic spine. The third part curves downward into the scrotum, and is equal in length to each of the two other parts of the incision. Its convexity is directed upward and inward. The external ring is exposed and any hernia treated in the usual way. The vas is isolated with its accompanying artery and vein. The cremasteric plexus of vessels and lymphatics is removed between ligatures.

A finger is introduced into the scrotum and the testicle brought down and placed in it, being retained by an assistant. The extremities of the middle part of the incision are then united by a curved incision whose convexity is directed upward and inward, and an oval flap of skin and subcutaneous tissues, extending down to the external oblique muscle, is dissected and isolated. This flap is then transferred to the scrotal part of the incision and sutured to both sides of it so that its lower apex lies in the lowest part of the scrotal portion. The rest of the wound is then sewed up in the usual way. By this means the scrotum is appreciably enlarged and, as it were, stiffened by a portion of tissue which contains no "dartos" muscle, and therefore remains uncontracted.

Operations for undescended testicle in childhood may be expected to yield 75 to 80 per cent. of satisfactory results. The spermatic circulation should, if possible, be preserved and the cord lengthened sufficiently to allow the

testicle to be placed in the scrotum without tension. In about 10 per cent. of cases, particularly those of the intra-abdominal variety, it becomes necessary to section the spermatic vessels. Atrophy follows this procedure in the great majority of cases. Atrophy may ensue, however, even where the spermatic vessels are not divided, probably because of accidental tearing of some of the trunks at operation, or their inclusion in the stitches, if the cord is anchored to Poupart's ligament. Operation may be undertaken at any age with the expectation of a good result, if the accompanying hernia becomes troublesome or other indications arise. The preferable age is between 5 and 12 years. Earlier than this the structures are so delicate that injury to the spermatic vessels is difficult to avoid. Orchidectomy should not be done in childhood. Replacement of the testes in the abdomen should also be avoided on account of the risk of future malignancy. Even in the most difficult case, section of the spermatic vessels and transposition of the vas and its accompanying vessels behind the deep epigastric will make it possible to place the testis in the scrotum. C. G. Mixer (Surg., Gyn. and Obst., Sept., 1924).

In **Polya's** new operation advantage is taken of separation of the testicle and epididymis by first dissecting the vas deferens from the former and then dividing the membrane between the testicle and epididymis, sparing the vessels. In this way 2 acute kinks are overcome and the testicle can be pulled down into the scrotum. The method is a valuable one. P. Bonem (Zeit. f. urol. Chir., xiv, 267, 1924).

In the *femoral variety* of misplacement, the **testicle** should be **returned to the abdominal cavity and held in place by a truss**. In the *perineal form*, the **operation for inguinal displacement** can occasionally be done.

When seen late in life, **castration** is always advisable, as the organ is

probably functionally useless, and is liable to sarcomatous degeneration.

Attention called to the possibilities from **endocrin treatment** in undescended testicle where the parents seriously object to surgical intervention.

For several years "mixed gland" tablets (male; B. W. & Co.) have been ordered taken nightly by the writer in such cases, and it seemed that the descent took place sooner than if left to nature. A small, undeveloped boy of 11 took 1 tablet nightly for 2 years, whereupon the right testicle finally took up its scrotal position. J. Wishart (Lancet, May 30, 1925).

Inversion of the Testicle.—The testicle may have descended to the base of the scrotum, and then assumed various faulty positions (anterior, lateral, horizontal, and rotary), the horizontal being the most common.

Examining 100 men, the writer found inversion of the testis 3 times. In 907 post-mortem examinations it was found 12 times. While seldom mentioned in surgical text-books, the condition has considerable importance. The testis is displaced so that the epididymis is in front and the body of the testis behind it. The tunica vaginalis lies posterior to the body of the testis and a hydrocele will, therefore, have the testis in front of it. Under ordinary conditions this displacement is never discovered. Serious danger threatens, however, when a hydrocele is tapped or operated on in such a case. Injury to the testis in tapping a hydrocele has, in the writer's experience, been a frequent cause of hematocele of the tunica vaginalis, and in only 1 such case had the testis not been inverted. In tapping a hydrocele that is not translucent, he advises entering the trocar on the outer side, instead of in front. Inversion of the testis probably predisposes to hydrocele, the author having met with it in 22 patients. In no case was the inversion bilateral. H. F. Waterhouse (Practitioner, Jan., 1926).

Luxation of the Testicle.—The testicle may be luxated from its normal position by blows, muscular action, and sudden contraction of the cremaster. It usually becomes rapidly inflamed and atrophy is frequent.

VARIETIES.—(1) Abdominal; (2) Crural; (3) Perineal; (4) Penile; (5) Inguinal.

TREATMENT.—When seen early the luxation should be reduced by **manipulation** and **traction**, a **pad** being applied **over** the **external ring**. When adhesions have formed, as in old unreduced cases, the **operation for undescended testicle** may be required.

Torsion of the Testicle.—The cord of an undescended testicle may be twisted as the result of congenital malformations. The symptoms depend upon the amount of torsion. There is usually inflammation and possible gangrene. This condition must be distinguished from strangulated hernia and epididymitis. In torsion the epididymis is anterior, while in *epididymitis* it is posterior. In a *hernia* there is an impulse on coughing and obstructive symptoms are present. *Simple orchitis* is to be distinguished by the normal anatomical arrangements of the parts.

TREATMENT.—*When seen early* the torsion is to be reduced by **manipulation** and **lead-water and laudanum** applied, with **elevation** and **rest in bed**. *After adhesions have formed* the **testicle and cord** must be **exposed**, the **twist reduced**, and the **testicle secured in proper position** by a few **sutures** on one side. Gangrene requires **castration**.

INJURIES OF THE TESTICLE.—When normally situated, the testicle is not often injured. Contusion from kicks, blows, and bruises upon

the saddle are not uncommon. There are usually an acute sickening pain, often faintness or syncope, followed by rapid swelling. An hematocoele or inflammation may ensue, followed by hydrocele and fibroid changes in the organ.

Incised, punctured, and gunshot wounds are occasionally met with, and require the same treatment as similar wounds of other parts of the body. Such wounds usually do well, and castration is seldom or never called for.

ORCHITIS.—An inflammation of the testicle is caused by gonorrhea, mumps, tonsillitis, tuberculosis, syphilis, and traumatism.

SYMPTOMS.—The symptoms of the simple inflammatory variety are as follows: Dull, sickening pain, radiating toward the hips and back; the testicle rapidly swells, but retains its ovoid form. Occasionally an acute hydrocele develops, and as a result there is an increase in swelling and pain. Occasionally suppuration takes place.

DIAGNOSIS.—Orchitis must be distinguished from *epididymitis*, which can be readily done by noting the position of the tenderness, this being posterior when the epididymis is involved.

TREATMENT.—The patient should be confined to **bed**, the **scrotum elevated**, and **applications of lead-water and laudanum made**. The **bowels** must be **kept open** and the pain controlled by **morphine**. *In the presence of an acute hydrocele*, **puncture of the tunica vaginalis** with a fine **tenotome** will often instantly relieve the pain. *After the acute symptoms have subsided* resolution may be hastened by **strapping** or the application of **mer-**

curial and belladonna ointments. Should an **abscess** form, it should be **opened** early, and treated on general principles.

Thirty cases of acute orchitis cured in 3 to 7 days by **intravenous injections of electrargol**, 5 c.c. (80 minims) daily or on alternate days. The effects are most pronounced at the beginning, when pain is limited to the groin and the tail of the epididymis, an abortive action being exerted. In a case in which electrargol proved impracticable on account of syncope, treatment with **cryogenin**, 1.25 Gm. (20 grains) a day, with **antipyrin** and **sodium salicylate**, 1 Gm. (15 grains) each, **caffeine**, 0.15 Gm. (2½ grains), and **sodium sulphate**, 20 Gm. (5 drams), was substituted, with recovery from the orchitis in 5 days. Mouradian (Ann. des mal. vén., Feb., 1922).

Tuberculous Orchitis.—Tuberculous orchitis is usually secondary to a like affection of the epididymis; the organisms, however, may reach the gland through the blood, and a primary focus develop. The disease is often bilateral, and is most commonly met with between the ages of 25 and 35.

SYMPTOMS.—The organ becomes hard, knotty, and irregular; there is a feeling of dragging weight and a sense of discomfort referable to the back. Sooner or later inflamed tissues become adherent to the skin, soften, break down, and rupture spontaneously, leaving fistulous openings, which exhibit little or no tendency to heal. There is little or no pain in the early stages of the disease. Not infrequently the disease has been preceded by tuberculosis of the lungs. Tuberculous testicle must be distinguished from *syphilitic orchitis*. The syphilitic testis is uniform, hard, painless, and seldom or never suppurates.

In not a few cases resolution takes

place. The disease may become encapsulated and cause no further trouble. In bad cases it may involve the epididymis, vas, prostate, and bladder.

TREATMENT.—The routine treatment consists in the internal use of **iodide of iron** and **codliver oil**, with **good food, fresh air, and sunlight**. *Locally*, the part should be kept at **rest**, and **iodide of lead ointment** applied. Should the disease progress, injections of **chloride of zinc**, from 3 to 5 drops of a 1 per cent. solution, may be made around the periphery of the focus every third or fourth day. A 10 per cent. emulsion of **iodoform and glycerin** may be used in the same manner, from 20 to 30 drops being used at each injection. *When the disease is circumscribed*, it may be **curetted** and touched with pure **carbolic acid**. Such a procedure will destroy the function of the organ. **Castration** is indicated when other measures have failed.

Metastatic Orchitis.—This is a frequent complication of mumps. One testicle is usually involved, and atrophic changes are exceedingly common. The symptoms and treatment are similar to acute orchitis.

For the first six days the following ointment should be rubbed in gently:—

℞ *Guaiacol* 3iiss (10 Gm.).
Lard 3ij (60 Gm.).

Envelop testicles in cotton and support them in a **suspensory bandage**.

At the end of the first week apply the following ointment:—

℞ *Mercurial ointment*,
Belladonna ointment,
Ichthyol,
Wool-fat .. of each 3j (4 Gm.).—M.

(Bull. gén. de thérap.; Monthly Cyclo., April, 1908).

Three cases of orchitis in which an **operation** was performed to prevent

atrophy. Under gas-oxygen the scrotum and tunica vaginalis are incised, the testicle delivered, an H-shaped incision made in the tunica albuginea, with other slits if necessary, the gland wrapped for a few minutes in a towel wet with hot salt solution, replaced in the tunica, a small Penrose cover inserted, the incision closed layer by layer, and a 25 per cent. **ichthylol** dressing applied. In the writers' cases the glands seemed normal after periods of 20 months to 3 years. Ballenger and Elder (Jour. Amer. Med. Assoc., Jan. 26, 1920).

Five cases of mumps, in 2 of which orchitis was promptly aborted and in 3 complications prevented by the use of **diphtheria antitoxin**. Thenebe (Boston Med. and Surg. Jour., Nov. 6, 1924).

Syphilitic Orchitis.—This condition usually occurs as a complication of the third stage of syphilis. The testicle is hard, indurated, somewhat irregular, and painless. Both testicles are often involved.

TREATMENT.—Mixed treatment, **biniodide of mercury**, $\frac{1}{2}$ grain (0.005 Gm.), with 20 grains (1.3 Gm.) of **potassium iodide**, should be administered thrice daily. *Locally*, inunctions of **mercurial ointment** are used.

TUMORS OF THE TESTICLES.

—Tumors of the testicles are rather uncommon, but cysts, adenomata, fibromata, chondromata, myxomata, carcinomata, sarcomata, and dermoids are occasionally met with. Cancer is by far the most common tumor affecting the testicle.

Symptoms.—Carcinoma is usually unilateral, making its appearance about middle life as a uniform swelling; the encephaloid grows rapidly, becoming nodular and irregular, and quickly breaking down and ulcerating, leaving a protruding fungous mass. The scirrhus occurs in older individ-

uals, and is of slow growth. As the disease progresses, the inguinal lymphatics become involved and also the lumbar. The general health rapidly fails, the face becomes cachectic, and the body emaciated.

In the last stages cancer might be mistaken for tubercle. However, the age, rapid growth, and ulceration would all point to malignant disease.

Treatment.—Early and complete **extirpation** is indicated.

Preoperative **irradiation** of the primary tumor deemed essential, the writer having observed a 23 per cent. lower mortality in cases thus dealt with. With adequate X-ray facilities, radical dissection of the lumbar and pelvic lymphatics seems to be unnecessary. The high-voltage **X-ray** was found to have certain advantages over the **radium pack**. Of 7 patients with operable tumors, 5 are living and apparently free from disease. Of 49 patients first seen with inoperable metastases, 10 are free from signs of disease. External irradiation alone was used in this group. Efficacy of the physical agents in teratoid tumors of the testis emphasized. A. L. Dean, Jr. (Jour. of Urol., Feb., 1925).

HYDROCELE.—This is a collection of fluid in the tunica vaginalis. It may be acute, as the result of extension of inflammation from either the epididymis or testicle; congenital, the result of anatomical deficiency in the vaginal and funicular processes; or it may be encysted. Often, however, the cause is not appreciable, although it is probable that traumatism and strains may favor the development of the condition.

In the acute variety of hydrocele, owing to the prominence of the symptoms of the primary condition, the characteristic symptoms are not pronounced. Pain is agonizing and is due to pressure. In the encysted form

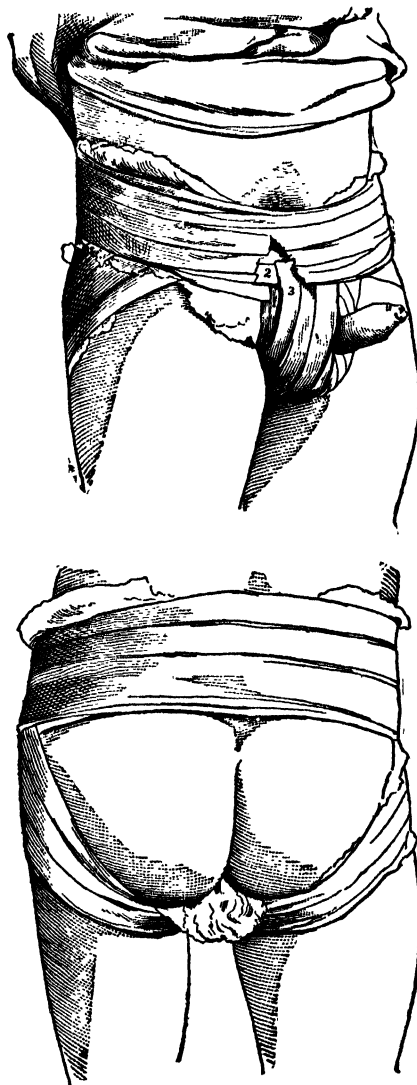
swelling, of slow formation, beginning at base of the scrotum and which is pyriform in shape, smooth, tense, fluctuating, and elastic on pressure, is noticeable; this does not, however, alter the size of the organ, which is dull on percussion, stands away from the body, and cannot be reduced. In the congenital variety the swelling is also of slow formation, dull on percussion, filling from below; it disappears when the patient assumes the recumbent posture, but returns slowly when he is in the erect posture. Such hydroceles are frequently complicated by hernia.

Diagnosis.—Hydrocele must be distinguished from *hernia*, *varicocele*, and *hematocele*. This can usually be done by the "light test." The patient should be examined in a dark room; a candle or lamp is held close to the scrotum, and by looking through the scrotum toward the light the swelling will appear translucent and at the same time the position of the testicle will be observed. This test may fail in thick-walled sacs.

Treatment.—In the *acute form* rest in bed, elevation of the scrotum, and application of lead-water and laudanum are indicated. When the pain becomes very severe, the sac may be punctured. After the acute symptoms have subsided, a well-fitting suspensory should be worn.

In the *encysted variety* treatment may be either palliative or radical. The *palliative* consists in tapping with trocar and cannula, drawing off the fluid, and repeating the operation as often as the sac refills. In *tapping* a hydrocele the swelling is made tense, and the trocar plunged in with a firm, quick, boring motion, being careful not to wound the testicle. A

spot on the scrotum free from veins should always be selected, so as to avoid the possibility of hemorrhage into the loose cellular tissue.



Compression bandage for scrotum. (Wickham.)
(La France médicale.)

Autoserotherapy was found effectual by Caforio in 45 per cent. of cases. In 4 bilateral cases he aspirated a few c.c. of the fluid on one side alone and reinjected it; the hydrocele on both sides retrogressed.

In operating for hydrocele the writer makes an incision 4 to 5 cm. long at the dependent part of the scrotum and tunica vaginalis, evacuates the fluid, and **packs** all of the cavity in the vaginalis **with a strip of gauze**. After 2 or 3 days the packing is withdrawn. No recurrence took place among 32 cases thus dealt with. Success was had similarly in 4 cases of spermatocele. Vecchi (Arch. ital. di chir., Mar., 1925).

The *radical treatment* may be carried out either by injections of irritating fluids or cutting operations. In the **injection** method, pure **tincture of iodine** is thrown into the sac after the withdrawal of the fluid. From a dram to an ounce (4 to 30 c.c.) may be used, according to the capacity of the sac. This method is especially valuable in thin-walled hydroceles.

The cutting operations include the open method, **Volkman's operation**, removal of the parietal layer of the sac, **von Bergmann's operation**, and the **Jaboulay** or **Winkelman's operation**—splitting the sac and turning it inside out, folding it above the testicle and cord, and so stretched that the endothelial lining is in contact with the new connective tissue of the scrotum. In the first the tissues of the scrotum and sac are incised, the sac sutured to the skin to prevent adhesions, and the cavity of the tunica vaginalis packed with iodoform gauze to promote healing from the bottom. In the second the parietal layer of the sac is removed through an incision of sufficient length, and the wound closed. These methods are preferable when the iodine method has failed or when the wall of the sac is thick.

Congenital cases can occasionally be cured by the application of a **truss**. If this fails, an **antiseptic seton** will usually prove successful.

SPERMATOCELE.—A collection of milky fluid in the tunica vaginalis containing spermatozoa gives rise to symptoms similar to hydrocele. This term is also applied to cysts usually situated between the testicle and epididymis. It is caused by dilatation of the vasa efferentia. They may vary in size from a pea to an orange. The treatment is the same as that for hydrocele.

HEMATOCELE.—This is a collection of blood in the tunica vaginalis, which may either be due to traumatism, disease, or occur as a sequel to the tapping operation for hydrocele.

The scrotum assumes a globular shape, the largest circumference being below. The tumor does not fluctuate and does not transmit light. Being abnormally heavy, it is unusually low.

Treatment.—**Rest in bed**, **elevation of the scrotum**, and the application of **lead-water** and **laudanum** are first indicated. After the acute symptoms have subsided, the **scrotum** should be **strapped**. When these measures fail, the **tunica vaginalis** should be **opened**, all **clots turned out**, and an **iodoform-gauze packing** introduced.

VARICOCELE.—This condition is due to dilatation, thickening, or tortuosity of the veins of the pampiniform plexus. It is most frequently observed in young men, is usually located on the left side, because the left testicle is the lower, and also owing to the fact that while the left spermatic vein opens into the renal vein at right angles and has no valves, the right spermatic vein opens obliquely into the vena cava and is supplied with valves. It may occur on either side at any time during life. It is caused by sexual abstinence,

pressure by a truss, abdominal tumors, arteriosclerosis, etc.

Diagnosis.—Varicocele is easily recognized, the vein, when the testicle is grasped gently and palpated, feeling like a bag of earth-worms. It disappears on lying down and refills from below when the patient stands and the external ring is compressed. Coughing also causes a slight impulse in the varicocele.

Investigation of the results of operation in 39 cases, the data being obtained 1 to 10 years after operation: 36 per cent. still had pain in the testicle or groin, 31 per cent. had tenderness in the testicle, 27 per cent. had sexual hypochondriasis. No atrophy of testis resulted from operation. Recurrence in 6 per cent. **Operation** was acknowledged as distinctly beneficial in 80 per cent. J. D. Barney (Boston Med. and Surg. Jour., March 17, 1910).

Three cases observed in Cairo, Egypt, which presented the usual clinical signs and symptoms of varicocele, but in which the swelling was due to the presence of tortuous coils of very thin-walled, dilated lymphatics in the substance of the spermatic cord. This condition, the writer believes, is a manifestation of filariasis, though he has not succeeded in finding filarial embryos in the blood. F. C. Madden (Lancet, Jan. 6, 1912).

Treatment.—A suspensory bandage and applications of cold water night and morning often suffice.

When the varicocele is a source of anxiety, an **incision** is made **over the external inguinal ring; separation of the vein from the vas and tying of its vessels** are then practised. The veins may be further separated almost to the epididymis, by drawing up the testicle into the wound and a second ligature applied. The **mass** is then **excised** and if the cord be very long

the **cremaster muscle** is **shortened**. The inguinal canal is sometimes found dilated by the varicocele; in that case **obliteration** is indicated as in the **Bassini operation**; otherwise, removal of the veins would leave an open canal.

To cure varicocele it is seldom necessary to open the tunica vaginalis or to resect the enlarged veins. The writer prefers the **Goodnight operation**, which is a simple **shortening of the scrotum**, and is performed in the following manner: Push the testicles high up in the scrotum and place a clamp across the scrotum just below the testicles in their high position. Cut away with sharp scissors or knife all the scrotum below the clamp. Release the clamp and pick and ligate all bleeding points with catgut. It will be observed when the clamp is removed that the tunica vaginalis has not been opened. Close the wound with interrupted silkworm-gut sutures. This will hold the testicles up permanently and take the weight off the cord, and does permanently relieve varicocele. If it is necessary in extreme cases, or where there is a hydrocele present, the tunica vaginalis can easily be opened through this incision, and it will not be found necessary to open higher up. R. O. Braswell (Med. Review, Jan., 1914).

The conventional operation (**resection of the pampiniform plexus and approximation of the two ends**) according to the writer possesses the great disadvantage that it not uncommonly causes degeneration of the testis. He has devised the following **operation** to obviate this: Inguinal incision; dislocation of the testicle through the wound and division of the Hunter ligament, so called, which fixes the testicle to the bottom of the scrotum; a narrow flap of fascia made from the aponeurosis of the external oblique is then formed with base downward; this is turned down into the scrotum and

sutured to the divided Hunter ligament; closure of the wound. In this operation, as is obvious, the testis is turned upside downward. The author's results have been excellent both functionally and cosmetically. R. Frank (Amer. Jour. of Surg., from Zentralbl. f. Chir., April 4, 1914).

All methods of complete or partial removal of the affected veins expose the testicle to some danger through the possibility of injury to the vas or the spermatic artery and cord vessels. The best procedure is excision of the principal spermatic veins together with removal of a diamond-shaped piece of scrotal skin, 12 cm. long by 5 cm. wide, with eversion of the tunica vaginalis and suspension of the testicle from the external inguinal ring. After replacement of the testicle in the common tunica and closure of the opening in the latter by purse-string sutures, the skin defect is closed by suturing in a vertical instead of a horizontal direction. Of 14 patients thus dealt with, some already had noticeable atrophy of the testis; reexamination after a number of years, however, showed atrophy only in 3, the glands in all the others being quite normal. There were no recurrences. E. Fiorini (Policlin., Sept. 15, 1924).

The writer disapproves of operative measures in varicocele, maintaining that the condition is simply an evidence of a general weakened state, and that upon institution of general **tonic measures** the varicocele will disappear of itself. Prima (Zent. f. Chir., Oct. 3, 1925).

EPIDIDYMITIS.—Inflammation of the epididymis may be inflammatory, syphilitic, or tuberculous. It commonly results from the extension of gonorrheal inflammations from the posterior urethra through the vas, but is sometimes due to syphilis and tuberculosis.

Two cases of acute epididymitis resulting from severe muscular effort. Most careful examination excluded gonorrheal infection, acute or chronic.

The condition has been reported before and attributed to the sudden violent contraction of the cremaster; but this muscle is too weak to do this. The explanation lies in the anatomy of the veins of the cord and testicle. They are long and have few valves. Marked increase in pressure, due to forced expiratory effort, together with the actual pinching off of their outlets at the ring, would suffice to cause rupture of the smaller branches. Edwards (Brit. Med. Jour., April 13, 1912).

Bilateral tuberculous epididymitis is less liable to entail azoospermia than the gonorrheal. The author's experience in over 1000 cases of azoospermia has been that it is incurable in about 80 per cent. of the bilateral gonorrheal cases; others have reported still higher percentages. On the other hand, a tuberculous process may leave the passage partly permeable. P. W. Fürbringer (Deut. med. Woch., July 17, 1913).

Meningococcic epididymitis developed 46, 23 and 15 days after the onset of severe epidemic meningitis. There was slight fever in only 1 of the 3 cases, and the epididymitis subsided, apparently without leaving a trace. While it lasted the features closely resembled those of the gonorrheal type. Lancelin (Bull. Soc. méd. des hôp. de Paris, Oct. 19, 1917).

Torsion of the testicle is often responsible for acute epididymitis and orchitis in boys. The writer has operated for this cause in 5 cases in less than 2 years. In 2 boys the symptoms were less severe, and the operation revealed torsion of the hydatid of Morgagni instead of torsion of the testis. A. Mouchet (Presse méd., May 30, 1923).

Symptoms.—These are of the *inflammatory type*: Tenderness along the cord, hard swollen vas, and pain in the back. The testicle rapidly swells, and becomes exceedingly tender, the patient walking with a stooping posture and the legs wide apart. When the inflammation is at its

height, general malaise, anorexia, and fever of 100° F. (37.8° C.) or over may be included in the clinical picture. On examination the tenderness and swelling will be found confined to the posterior part of the scrotum. An acute hydrocele by contiguity may result. Suppuration is rare, the general tendency being always toward resolution. Traces of the attack often remain for a long time after the inflammation has subsided, the regular outline of the organ being interrupted by masses of lymph. In about 60 per cent. of the cases of double epididymitis the patient remains sterile. *For the relief of sterility*, Martin has suggested an **operation** which consists in exposing the vas and the epididymis. A prominent bunch of tubules of the epididymis is incised and if found to contain living spermatozoa the vas is incised and an anastomosis made between the two organs at that point.

The *syphilitic* variety is usually noted as a complication of the secondary period, and consists of small, gummatous lesions.

The *tuberculous* variety may be primary, but is often secondary to that of the testicle or prostate. The disease usually begins in the head of the organ as a series of nodules, of slow growth, which become adherent to the skin, soften, and leave a fistulous opening. This form is usually followed by sterility on the affected side.

Treatment.—In the *simple inflammatory form* **rest in bed, elevation of the scrotum, and lead-water and laudanum or hot fomentations** are indicated. The application of an ice-bag will greatly relieve the pain, but it increases the induration, and in my experience is a frequent cause of suppuration by devitalizing the part.

In gonorrheal epididymitis, Bethune recommends **support of the scrotum** and application of the following ointment: *Menthol*, gr. xv (1 Gm.); *ung. belladonnae*, gr. xx (1.3 Gm.); *ung. Credé*, gr. xxx (2 Gm.); *ichthyolis*, 3j (4 Gm.); *petrolati*, q.s., ad 3j (32 Gm.). Where the swelling of the epididymis does not quickly resolve, he **straps the testicles**, thus: Envelop affected half of scrotum in a square of gauze. Press testicle into bottom of scrotum with thumb and index finger and bind a strip of adhesive above the organ, holding it down. Then pass other strips, starting at the first one, around under the testicle and up the opposite side until the organ is covered. Finally, secure with another transverse strip over the first. Support with a **suspensory**. Renew the strapping every other day.

Passive hyperemia by Bier's method in gonorrheal epididymitis may be used, according to A. C. Wilson, by first passing a strip of lint bandage around the cord on the affected side, just above the testicle. This is continued along the median raphé between the two testicles, and over it is applied a piece of fine rubber tubing, which is then tightened until no pain results after its application. It is held by artery clamps, and allowed to remain usually for an hour on the first day, increased later up to as long as 8 hours a day. There is immediate relief of pain; the patient can often return to work in less than 2 days. It is well to continue all of the usual measures employed. The method also shortens the treatment, and is applicable to all chronic and most of the acute cases.

In acute gonorrheal cases, the writer prescribes **sodium salicylate** and **sodium iodide**, of each 10 Gm. (2½ drams), in distilled water, 200 c.c. (6¾ ounces). One tablespoonful is given 3 or 4 times a day until complete absorption has occurred. Isacson (Berlin. klin. Woch., Aug. 22, 1921).

In subacute cases, the **therapeutic lamp**, containing a 100-watt blue nitrogen bulb, allowed to shine upon the scrotum overnight, often results in subsidence of inflammation after 2 nights. In acute cases, similar treatment is used, but with the scrotum covered with 4 or more layers of gauze wrung out in hot saturated mag-

nesium sulphate solution. E. W. Hirsch (Urol. and Cut. Rev., Aug., 1921).

Early **X-ray** treatment advocated, about 75 per cent. of a skin unit dose being used first anteriorly, then posteriorly over the affected epididymis. One exposure generally suffices. Wetterer (Dent. med. Woch., Apr. 7, 1922).

Gratifying results in 90 cases from **sodium iodide intravenously**. The usual dose was apparently 2 Gm. (30 grains). The average number of injections required is 4 or 5, with a total range of 2 to 10. The injections are generally given at first every other day for the first 3 or 4 doses, then every 3 or 4 days. **Guaiacol** and **diathermy** locally help to hasten resolution. Attention to the bowels and **avoidance of undue exercise** are indicated. For scrotal support the writer prefers the **T binder** or the ordinary athletic **suspensory** (jock strap). In severe cases the scrotum can be anchored up against the abdomen with adhesive. Ravich (N. Y. Med. Jour., May 3, 1922).

Calcium chloride intravenously is a very valuable adjunct in gonorrheal epididymitis. In 17 cases, all but 1 ambulatory, 10 c.c. (160 minims) of a 10 per cent. solution were injected every 3d day; 1 to 6 injections were required. **Urotropin** and **acid sodium phosphate** were also given. After a calcium injection there is a feeling of heat, then a sedative effect, and the pain from the epididymitis disappears usually within ½ hour. The temperature falls. There is rapid subsidence of swelling and absorption of exudate. A. E. Cerf (Therap. Gaz., Mar., 1924).

Diathermy regarded as specific in gonorrheal epididymitis. B. C. Corbus and V. J. O'Connor (Jour. of Urol., Aug., 1924).

Turpentine injections deserve a prominent place in the treatment of epididymitis. A 20 per cent. emulsion of it in olive oil is injected upon the pelvic bone fascia on alternate days in doses of 0.5 to 1 c.c. The injections per case averaged 3 to 4. A. A. Wren

and J. L. Tenenbaum (Surg., Gyn. and Obst., Oct., 1924).

When the pain is severe, the acute **hydrocele** may be **punctured**. In the very severe cases, and especially those which do not undergo prompt resolution, it may be necessary to perform **epididymotomy**. The operation of epididymotomy after my method consists in the administration of gas anesthesia and plunging a very fine, straight, sharp-pointed bistoury from the base of the epididymis to the top; this is usually followed by the escape of blood and small areas of purulent collection, thus relieving the pain almost instantly. An **antiseptic dressing** is applied and the testicle kept surrounded with **hot normal salt solution**. Resolution usually takes place promptly.

The **Hagner operation** is much too severe to be considered except in rare instances, because this operation requires an incision in which the testicle is removed from the scrotum and a trocar passed up through the epididymis. The after-treatment is the same. After the acute symptoms have subsided, the **testicle** should be **strapped** and small doses of **potassium iodide** given internally to favor resolution.

Epididymotomy always affords immediate and permanent relief of pain, shortens the inflammatory process, reduces the chances of sterility, and permits of starting treatment of urethritis much earlier. As an office operation the writer uses a procedure differing from **Hagner's operation** only in minor details. The anesthetic consists of 20 to 30 c.c. of 5 per cent. **novocaine** with 3 to 6 drops of 1:1000 **adrenalin**. The cord is first grasped where it emerges from the external ring and infiltrated; 5 to 10 c.c. of solution are injected in all directions,

with a little in the inguinal canal. Next the needle is pushed downward along the cord to the globus major and more solution injected. The scrotum is then circumjected to the perineum on the affected side; injection is made where the scrotal skin merges with that of the thigh. Finally, a small amount is injected along the line of incision, which is made laterally so that the tunica vaginalis is opened near the epididymis. Adhesions are now freed and the testicle and epididymis delivered through the incision. Multiple punctures with a tenotome are made in the indurated area, whether there is visible pus or not. The testicle and epididymis are next infiltrated with **warm saline solution** and the vas injected with 2 per cent. **mercurochrome** solution. A drain is placed along the epididymis and brought through the lower end of the incision. The testicle is returned to the tunica and the wound closed loosely with silkworm gut sutures, thus allowing hydrocele fluid to escape readily. The patient takes a cathartic and remains in bed 2 days. The gauze wick is removed in 3 or 4 days and the sutures in about a week. T. M. Dorsey (Amer. Jour. of Surg., Apr., 1924).

The *syphilitic form* requires the usual antisyphilitic measures. The *tuberculous type* is met by the measures indicated in tuberculosis of the testicle.

CASTRATION.—The operation for the removal of the testicle is indicated when tumors, tuberculosis, gummata (occasionally), or extensive suppuration are present, and in certain cases of undescended testicle.

Operation.—The testicle being made prominent, an incision is made from the base of the scrotum to the external ring. When the skin is involved, two elliptical incisions should be made. The testicle, with its tunics, is now quickly freed and the cord exposed. While traction is be-

ing made, a double catgut ligature is passed through the cord, with an aneurism-needle, the loop cut, and the needle withdrawn. The cord is then ligated in each half and once around, and divided $\frac{1}{4}$ inch below the ligature. The stump is cauterized with pure phenol to prevent infection of the wound from the vas. All hemorrhage being controlled, the wound is closed by silkworm-gut sutures, the operator being careful to evert the skin-edges.

IMPLANTATION.—G. F. Lydston found that successful total or partial implantation of human sex glands in both male and female was practicable. Glands taken from the healthy dead body at any time prior to the beginning of decomposition were deemed by him of therapeutic value equal to that of those taken *in vivo*, if implantation succeeded. The benefits of implantation probably accrue irrespective of the site of the implantation. The development of **senility**, Lydston averred, possibly can be retarded and longevity increased by implantation. The **climacteric** may be postponed by it, or its disagreeable features relieved. **Defective and aberrant psychical or physical sex development and differentiation—inversions and perversions**—are definite indications for sex gland implantation. Certain cases of **cryptorchidism** and **imperfect testicular development** are a promising field for it. Certain types of **chronic eczema**, **psoriasis**, and **ichthyosis** apparently are likely to be benefited and possibly cured. That early **arteriosclerosis** may be benefited is probable.

Renewed interest in transplantation was aroused through the widely heralded experiences of Voronoff and Steinach. The former ("Greffes testiculaires," Paris: Doin, 1922), after preliminary experiments in sheep and goats, implanted grafts of chimpanzee testes in 7 human subjects, in some instances to replace loss through bilateral orchidectomy and in the others for senility. The results on the whole were less satisfactory in the former than in the latter, in whom a definite stimulating effect was observed. Mühsam (Deut. med. Woch., Oct.

6, 1922) reported transplantation of human testicles in 5 cases, with apparent marked success in 3 instances and fleeting improvement in 2. A man aged 26 with bisexual inclinations began to experience heterosexual desire after the operation, married, and became the father of a child. In a homosexual, there was a temporary change to heterosexuality. A castrated and impotent man aged 25 began to experience libido 7 months after the operation, with change of voice and enlargement of the prostate to normal size, and married; coitus took place regularly every 2 or 3 weeks. Another homosexual became heterosexual 6 months after the operation.

Thorek (Paris chir., Oct.-Nov., 1923) recorded 36 homotransplantations and 61 heterotransplantations in 69 cases of **senile atrophy**, 11 of **destructive conditions of the testicles** (injuries, tuberculosis, sarcoma, suppuration), 8 of **neurasthenia** and **impotence**, 5 of **psychosis**, and 4 of **Fröhlich's disease**, **eunuchoidism** and **diminished genital activity**. Complete symptomatic restoration was obtained in 45 per cent. of the 1st group, and varying improvement in all groups. Complete failure occurred in 18.8, 27.3, 37.5, 40 and 25 per cent., respectively, of the several groups above mentioned. According to the same observer (Urol. and Cut. Rev., Nov., 1923), sons and near relatives are ideal donors for transplantation. Transplants may also be taken from sexually mature higher anthropoid apes, in which case the entire testis is used. With a human donor, $\frac{1}{2}$ of the testis is excised, reconstructed and implanted, and the remaining $\frac{1}{2}$ in the donor is reconstructed. The testis is stripped from the tunica vaginalis and small pieces of the tunica albuginea snipped out with scissors (laternization), causing protrusion of testicular substance. A later procedure is to expose the tunica vasculosa and promote vascularization with the contiguous membranes by careful use of the thermocautery. The implant is then imbedded. Either the subperitoneal space, or better, the retrorenal space is used as the site of implantation.

H. L. Hunt (N. Y. State Jour. of Med., Dec., 1923) made 84 ovarian or testicular implantations, with markedly successful results in all but 8. Sheep's ovaries and ram's testicles were found best.

K. M. Walker (Lancet, Feb. 16, 1924) found grafts from cases of **ectopia testis** the most available human material. He placed them usually in the tunica vaginalis. In 10 cases the results were, in general, distinctly promising. In 4 there was a definite effect on carbohydrate metabolism, and in 2, an increase in the respiratory exchange.

Aside from testicular transplantation, the term **rejuvenation** has been applied also, with dubious propriety, to **Steinach's operation (vasoligation)** in which ligation of the vasa deferentia is carried out to cause, through back-pressure, an atrophy of the seminiferous portion of the testis, followed, in turn, by a proliferation of the interstitial cells, which, through an internal secretion, reactivate the entire endocrin system. The operation differs from the vasectomy used for sterilization of criminals only in that the vasa deferentia leading from the testis to the epididymis are sometimes divided instead of the vas deferens itself; this is done in order to spare the deferential artery. In the original operation, an incision 4 to 6 cm. long is made next to the root of the penis over the spermatic cord. The vas having been well laid bare for 3 cm., 2 thick ligatures are placed around the upper portion, $\frac{1}{2}$ cm. apart, and another around the lower portion. About 2 cm. of the vas are then resected. As described by H. Benjamin, the interstitial tissue now begins to proliferate, taking the place of the degenerating seminal epithelium. "After several months a more or less complete regeneration of seminal cell tissues takes place, but it seems that the hypertrophy of the Leydig cells persists to a certain extent."

While numerous cases have been reported in which improvement followed this operation, the results as a whole appear to have been less definite and more difficult to distinguish from the effects of suggestion than in the case of testicular transplantation. According to Schinz and Slotopolsky (Deut. med. Woch., Apr. 3, 1925), the stimulating effect of vasoligation is due to absorption of destroyed seminal epithelium, and not to increased functioning of a "puberty gland." They deem the operation indicated only for sterilization and as a last recourse in premature organic **impotence**.

ELLWOOD R. KIRBY,
Philadelphia.

PEPO.—Pepo, U. S. P., or pumpkin seed, is the dried ripe seed of *Cucurbita pepo*, family Cucurbitaceæ. The seeds contain a resin, an alkaloid (cucurbitine), oil, starch, sugar, etc. Before administration the seeds are crushed and beaten into a paste with milk and white sugar, and the resulting emulsion strained; or the seeds may be first decorticated and the contents then rubbed up with milk or water and sugar. Pepo has a distinct diuretic action, but it is chiefly used as a very efficient and harmless tæniacide, in doses of 1 to 2 ounces (30 to 60 Gm.), prepared as before stated, taken on a fasting stomach, and followed in from one to two hours by an active purge. The resin (unofficial) has been given in doses of 15 grains (1 Gm.). The combination with oleoresin of aspidium (male fern) is effectual in destroying the **tape worm**: Oleoresin of aspidium, 1 dram (4 Gm.); chloroform, 10 minims (0.6 c.c.); emulsion of pumpkin seeds, 12 ounces (375 c.c.). To be divided into 2 doses, taken one hour apart, on fasting stomach, and followed by 1 ounce (30 c.c.) of castor oil an hour later. W.

PEPPER (Black Pepper).—Piper, N. F. (black pepper) is the unripe fruit of *Piper nigrum*, family Piperaceæ, a woody, evergreen, diœcious climber. It is a native of India and the neighboring islands. The berries are small, pungent and spicy to the taste, and of aromatic odor. They contain piperine or piperina (4.5 to 8 per cent.), a pungent resin, a volatile oil (2 per cent.), dipentene, phillandrene, a peculiar terpene, and starch, but no tannin.

PREPARATIONS AND DOSES.—*Piper*, N. F. (black pepper). Dose, 5 to 20 grains (0.3 to 1.3 Gm.).

Oleoresina piperis, U. S. P. IX (oleoresin of pepper). Dose, $\frac{1}{4}$ to 1 grain (0.015 to 0.06 Gm.), best given in pill form.

Piperina, U. S. P. VIII (piperine). Dose, 3 to 6 grains (0.20 to 0.40 Gm.).

Confectio piperis, Br. P. (confection of pepper, 10 per cent.). Dose, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.), several times daily.

PHYSIOLOGICAL ACTION.—Pepper is a powerful local and general stimulant. Its resin content imparts a burning taste and in large doses may cause distinct irritation of the mucosa of the mouth and throat. In large doses it may excite gastro-

enteritis, and has produced delirium, rigors, and convulsions.

THERAPEUTIC USES.—Pepper has been used as a condiment and to increase the secretion of the gastric and intestinal fluids and to reduce flatulence. In atony of the mucous membrane of the genito-urinary system it is of decided value, but the presence of acute inflammation, as in gonorrhœa, contraindicates its use. Piperine, formerly used in malarial disorders, may be employed with the cinchona alkaloids to increase their absorption and efficiency. Used externally, pepper, in the form of poultice or plasters, relieves headache, colic, muscular rheumatism, and neuralgia. The British confection of pepper, a substitute for "Ward's paste," is employed as a remedy for anal fissure, hemorrhoids, and rectal ulcers. W.

PEPPERMINT. See MENTHA.

PEPSIN.—Pepsin (pepsinum, U. S. P.) is a substance containing a proteolytic enzyme obtained from the glandular layer of the fresh stomach of the hog, and capable of digesting not less than 3000 times its own weight of freshly coagulated and disintegrated egg albumin, when 0.1 Gm. of it is combined with 150 c.c. of a 3.316 per cent. solution of hydrochloric acid and maintained for $2\frac{1}{2}$ hours at a temperature of 52° C. (125.6° F.), the vessel in which it is contained being agitated by inversion every ten minutes. At the end of the given time not more than 1 c.c. of undissolved albumin should remain. Pepsin occurs in yellowish-white or white scales or in powder, having a slight acid or saline taste, and should be free from odor. Much of the commercial pepsin is adulterated or contaminated with peptone, and may also contain mucus and albumin. The peptone is detected by its peculiar musty odor, and, if abundant, it will absorb moisture and become sticky when exposed to the air.

PREPARATIONS AND DOSES.—*Pepsinum*, U. S. P. (pepsin), 1 to 10 grains (0.06 to 0.65 Gm.).

Besides the official preparation, there are others on the market which may be preferred. Elixir pepsini et rennini compositum, N. F. (essence of pepsin, 1 to 4 drams—4 to 15 c.c.); Elixir pepsini compositum, N. F. (compound digestive elixir,

1 to 4 drams—4 to 15 c.c.); Glyceritum pepsini, N. F. (45 minims—3 c.c.); Liquor pepsini, N. F. (1 to 4 drams—4 to 15 c.c.), and Liquor pepsini aromaticus, N. F. (1 to 2 drams—4 to 8 c.c.), are available fluid preparations.

PHYSIOLOGICAL ACTION AND

THERAPEUTICS.—The terms “peptonized” and “peptone” are so fixed in the popular mind in association with pepsin that many continue to regard a peptonized food as one made with or containing pepsin. Pepsin is not available for peptonizing food for the sick in the household. Its action is not only restricted to albuminous (proteid) substances, but, acid being indispensable, the product is, for this reason, unsuitable as a food. In the laboratory it may be used and is used, for there the acids are removed and the products are properly clarified. Pepsin is useless in the artificial digestion of milk. Pepsin cannot be used for the artificial digestion of food at the table in the way that pancreatic extract may be.

Hamburger asserts that fresh and inactivated animal serum, under proper conditions, will bind pepsin quantitatively in weak acid solution and will prevent it from digesting proteid, even after the addition of free hydrochloric acid in excess. This binding and inactivation of pepsin cannot be considered as due to a specific antipepsin. This phenomenon has been termed “pepsin deviation” in analogy with the deviation described for other ferments, notably trypsin. This ability of animal serums to deviate pepsin explains the published accounts of the so-called “anti-pepsin.” It has been found impossible, by the use of a technique elaborated to control pepsin deviation, to demonstrate normal antipepsin in the blood-serum of the dog, cat, guinea-pig, cow, horse, rabbit, and of man.

According to Aldor, pepsin, even in large quantities, has no inhibitory action on lactic acid or other fermentation, and whatever inhibition is exerted by native or artificial gastric juice depends on the hydrochloric acid.

In using pepsin, or other digestive ferment, certain points should be observed, lest the ferment become inert before ingestion. A digestive ferment should never

be mixed with water or any fluid of a higher temperature than can readily be borne by the mouth. In the peptonizing process, in sprays, in surgical solvents, too high temperature should be avoided. Pepsin is destroyed in alkaline solutions (with lime-water, sodium bicarbonate, aromatic spirit of ammonia, etc.). All ferments in solution soon decompose unless in the presence of an antiseptic. The ferments should not be mixed undiluted with strong, alcoholic tinctures or astringents. Pancreatic ferments should not be placed in acid mixtures. Pepsin and pancreatic ferments should not be mixed together in solutions, acid or alkaline. These mixed ferments cannot be permanently held in an active form in any solution. (Fairchild.)

Pepsin is best given with or immediately after food (as its digestive action is solely expended upon the proteids, which action takes place at once in the stomach), combined with hydrochloric acid (as the presence of the acid converts any pepsinogen in the gastric tubules into pepsin), as an aid to weak digestion. Pepsin is useful in **atonic dyspepsia**, especially in that present during **convalescence from acute diseases**. **Gastric irritability** is relieved by pepsin combined with bismuth in powder (bismuth in solution is incompatible with pepsin).

Pepsin is of value in **gastralgia**, **pyrosis**, **gastric catarrh**, and **infantile apepsia**. In **gastric ulcer** and in **carcinoma of the stomach** pepsin relieves the vomiting and assists the impaired digestive organs.

Pepsin is an efficient digestive ferment only in **proteid digestion**. It is useless in intestinal indigestion, as it has no solvent action upon fats or starches. As a remedy for **indigestion**, pepsin is much inferior to pancreatin (pancreatic extract) or papain.

In **infantile diarrhea** arising from indigestion pepsin is a useful adjunct to other treatment; essence of pepsin given in doses of 10 to 30 drops immediately after nursing will assist in the digestion of the milk-curds. In this disorder peptonized milk will give better results than pepsin.

In **typhoid fever** 5 grains (0.3 Gm.) of pepsin combined with 10 drops of dilute hydrochloric acid, given in a wineglassful

of water, after nourishment, three times daily, will be found useful in assisting the impaired digestive powers and in controlling the febrile movement.

Pepsin has been used as a surgical solvent. It is claimed that it will dissolve **blood-clots** in the **urinary bladder**, and render their expulsion easy. It has been used in **diphtheria** and **membranous croup** to dissolve the false membrane. For this purpose it may be applied in powder by insufflation, or in solution by spray or applicator (brush or probang).

Pepsin has been used as a local application to **cancers** and the unhealthy surfaces of **severe burns** and **sloughing ulcers**, with the view of removing sloughs and dead bone; and to **abscess cavities** and **sloughing wounds** to remove the dead tissue and bring about a clean, healthy condition. Glycerole of pepsin is best fitted for this use, although the dry powder or scales have been successfully employed for this purpose. W.

PERFORATING ULCER OF FOOT.—This is a condition in which an opening exists communicating with a sinus leading to diseased bone, and often surrounded with granulations.

SYMPTOMS.—The circumjacent skin is but slightly inflamed, but sometimes ulcerated. As a rule it is usually located over the metatarsophalangeal joint of the great or little toe, although other parts may be attacked either single or multiple; the affection may be located in one or both feet. A corn or callosity usually appears first and suppuration occurs underneath, and a sinus forms, opening in the center of the thickened epidermis. The sinus becomes deeper, and if unchecked reaches the bones and joints and disintegrates them. The discharge is usually slight and blood-stained, and the opening is found to lead down to diseased bone. Pain is frequently slight or absent, the insensibility of the diseased spot being generally marked; anesthesia is present over an irregular area, reaching at times nearly to the knees, the toes being especially without feeling. The local temperature is usually subnormal. During the primary stage of the disease sweating is very free. Distortion of the toes result from organic

changes which take place in the tendons. The nails are yellow in color and cracked and twisted to one side. The trophic changes are due to a thickening of the endoneurium, with compression and disintegration of the sensory nerve-fibers.

ETIOLOGY.—Perforating ulcer is usually caused by anesthesia of the sole of the foot, which allows repeated or long-continued irritation to pass unheeded. Contusion of the foot, through injury of a peripheral nerve, may give rise to the disease, or the nerve lesion may be of central traumatic origin. It is encountered in many diseases—tabes dorsalis, leprosy, the peripheral neuritis of alcohol, syphilis, and diabetes. More rarely it may be preceded by epithelioma, a neglected corn or callus, or some local injury. The pain may be marked in these cases. Hofmann, in 15 patients under his care, discovered only 1 case of organic nerve lesion, and attributed the disease to chronic alcoholism, in the form of wine drinking, combined with heavy manual labor.

PROGNOSIS.—Owing to the liability to recurrence of the affection from the persistence of the nerve lesions, even after healing, the prognosis is uncertain.

TREATMENT.—In the early stages **relief of pressure**, by **confining** the patient to a **chair** or by prolonged **rest in bed** or even the employment of an **artificial limb** fastened to the bended knee, will cause temporary healing, especially if the **thickened epidermis** is **removed**, after macerating it with a **poultice**, or by thoroughly soaking the foot in **hot water**, the **sinus** **disinfected** and **drained**, and stimulated by applications of weak solutions of **silver**, **nitrate** or **copper sulphate**, or **balsam of Peru**.

Piccioli and Baroni have **stretched** the **plantar** and the **tibialis nerves** in these cases in connection with **curettement** and **freshening of the ulcer**, and the **removal of necrotic material**. They suggest that a more decided effect might be obtained by **stretching** the **sciatic nerve** under local anesthesia.

In advanced cases a **Syme** or **Pirogoff** **amputation** may be indicated; in exceptional cases **amputation below the knee**, beyond the area of anesthesia, will alone afford relief. W.

PERICARDITIS. See HEART AND PERICARDIUM, DISEASES OF THE.

PERICARDIUM, DISEASES OF. See HEART AND PERICARDIUM, DISEASES OF THE.

PERIHEPATITIS. See LIVER AND GALL-BLADDER, DISEASES OF THE.

PERINEUM, DISORDERS AND SURGERY OF. See PREGNANCY AND PARTURITION, DISORDERS OF.

PERIOSTITIS. See BONES, DISEASES OF.

PERIPHERAL NERVES. See NERVES, PERIPHERAL, DISEASES OF.

PERITONEUM, DISEASES OF THE.—There are two theories in regard to the development of the peritoneum. According to one, the cavity and its lining is a mesoblastic formation, and the endothelium is derived from the mesoblastic cells like that of the blood-vessels. On the other hand, certain anatomists hold that the peritoneal cavity is an offshoot of the original intestinal canal, formed of hypoblastic or epithelial cells. The epithelium becomes transformed into endothelium, and a connection with the lymphatic system develops later. This conception furnishes an explanation of the tendency on the part of the membrane to undergo carcinomatous change.

The great power of absorption of the peritoneum is both a menace and a defense. It is particularly active in the diaphragmatic layer and in the omentum, which latter attaches itself to any inflamed surface and acts as a barrier to the spread of microbic infection. By virtue of this absorptive power, invading microorganisms are carried off before they

can multiply *in situ*; while, on the other hand, the conditions for a general toxemia are, at the same time, rendered more favorable. In case of bacterial invasion, absorption is diminished by the inflammatory engorgement of the blood-vessels, by lymphatic engorgement, by the movements of the diaphragm, and by the limitation of peristalsis. A copious exudate in the peritoneal cavity may act favorably by diminishing absorption. The peritoneum differs in certain important respects from the other large serous membranes. It is much more sensitive to infection, and less resistant to the action of pathogenic organisms than the pleura and pericardium; but, while subject to almost every kind of infection, it appears to be immune to the microorganism causing the type of arthritis loosely designated rheumatism. Among the defensive equipment of the peritoneum may be mentioned also the phagocytic activity of the endothelial cells and of the leucocytes contained in the peritoneal fluid, and its bactericidal and antitoxic qualities. Anatomically a difference in the relations of the peritoneum in the male and female is to be noted, inasmuch as in the female the membrane communicates with the atmosphere through the Fallopian tubes (which furnishes an explanation of certain infections occurring in young girls). On the other hand, the pelvic peritoneum is thicker in women than in men.

Certain congenital bands and membranes, which have been studied and described in recent years, may manifest their morbid effects in the course of diseases of the intestinal tract, rather than of the peritoneum itself.

The most important of these are the so-called Lane's kink, a band of tissue at or a little above the ileocecal valve, and Jackson's membrane, consisting of web-like adhesions covering the cecum and ascending colon.

ASCITES.

The presence of free fluid in the peritoneal cavity has been treated from the surgical viewpoint in the first volume of this work (see ASCITES). The present section refers to the medical side of the subject.

When the accumulation is due to congestion it is spoken of as a transudate, or the term "hydroperitoneum" may be employed. In most cases of ascites, however, the process is in part inflammatory and in part the result of passive venous or lymphatic engorgement. The fluid is pale yellow or greenish in color, clear, of a specific gravity varying from 1.010 to 1.018, depending on the cause of the ascites, inflammatory exudates having a higher specific gravity and a greater protein content than fluid due to backward pressure. The reaction is alkaline. Blood-stained fluid occurs with malignant disease of the peritoneum, sometimes in cirrhosis, and in tuberculous peritonitis. The color may be yellow in jaundice. Chylous effusions may occur from leakage of chyle through the lymphatic vessels into the abdomen when there is obstruction in the course of the thoracic duct or lymphatic trunks. This form must be distinguished from fatty or chyloform ascites, or the formation of fat in a peritoneal effusion. The latter is usually associated with chronic peritonitis, either simple or tuberculous, or with intra-abdominal neoplasms. The cytology

of peritoneal effusions has some diagnostic importance: in transudates the endothelial elements predominate; tuberculous peritonitis is characterized by a high lymphocytosis; while in other forms of infection, polymorphonuclear leucocytes are chiefly found. When several causes are operative at the same time, as, for example, cirrhosis of the liver and tuberculosis, the characteristic cells of each affection may be present in equal numbers.

Ascites may be general or circumscribed, the latter form being more commonly due to disease of the peritoneum, although, in general, dropsy adhesions may at times limit the collection of fluid. It is under such conditions that differential diagnosis assumes the greatest importance.

SYMPTOMS.—The quantity of fluid varies from a pint or two to several gallons, and its presence is recognized by physical examination. Constipation, gastrointestinal disturbance, and interference with respiration, when the quantity is large, may suggest the presence of ascites, but the symptomatology is vague.

DIAGNOSIS.—Inspection discovers the globular shape of the abdomen, with sagging at the flanks in the recumbent, and bulging below the navel in the sitting posture; engorgement of the cutaneous veins (*caput medusae*); distention of the skin and *linea albicantes*; prominence of the navel, and restriction of respiratory movements. The apex beat of the heart is displaced upward. Fluctuation or thrill is elicited by gently tapping one side of the abdomen with the fingertips and feeling the "thrill," or impingement of the waves of ascitic fluid on the palm of the other hand

in contact with the opposite side. This sign can be elicited only when the abdomen is so distended with fluid that the diagnosis can practically be made at a glance, and is therefore of little value in doubtful cases. *Percussion* is the most reliable method of examination in all doubtful cases. Areas of dullness are discovered in the flanks in the dorsal posture, increasing in extent on one side or the other as the patient is brought into the lateral position. The tendency of distended coils of intestine to float up against the abdominal wall sometimes obscures the findings and must be remembered. By careful percussion, noting the changes in the limits of dullness in the various postures—dorsal, lateral, and sitting,—even small quantities of fluid in the peritoneal cavity can be detected by careful percussion.

Conditions which must be differentiated from ascites are chiefly ovarian cyst, a distended bladder, pregnancy, and large abdominal tumors. Mistaking an *ovarian cyst* for ascites will be avoided by remembering that, whereas in the latter the intestines float up against the anterior abdominal wall, causing a tympanitic note in the umbilical region, an ovarian cyst, like any other large abdominal tumor, displaces the intestines and comes in direct contact with the anterior abdominal wall. Hence dullness at and about the umbilicus in ovarian cyst, instead of tympany, and absence of bulging and dullness in the flanks. Rarely an abnormally short mesentery holds the intestines down, and there is dullness at the umbilicus in ascites; again, ovarian cyst and ascites may be present at the same time. The tumor of

pregnancy and a *distended bladder* can readily be differentiated from an effusion if the conditions are thought of and ordinary care is exercised in examination. In the presence of ascites *chronic peritonitis* may be overlooked if, as is often the case, the general symptoms are mild. A history of cardiac, hepatic, or renal disease, the symmetrical character of the enlargement, the absence of pain and fever, and the absence of tumor masses after the fluid has been drawn off, will aid in avoiding this error.

The nature of the fluid varies with the cause of the ascites and is of diagnostic value. In *simple dropsical effusions* the fluid is clear and serous, occasionally slightly tinged with blood in old cases of *cirrhosis*. Hemorrhagic fluid, when obtained at the first tapping, is suggestive of *cancer or sarcoma*; it is also found in *tuberculous peritonitis* and in *multiple serositis*. After *rupture of a viscus, an aneurism, or the sac of an ectopic pregnancy* the fluid obtained is deep red, or consists almost entirely of fresh and shed blood (hemoperitoneum). Chylous fluid is sometimes obtained after an *excessive milk diet*, and occurs in cases of *Filaria sanguinis hominis* from disease of the lymphatic vessels. Ascites associated with a tumor points to *malignancy*.

ETIOLOGY.—The causes of ascites are in the main obstructive, as in heart disease and cirrhosis of the liver, and toxic, *i.e.*, due to the action of a toxin on the endothelial cells of the peritoneum, as in acute and sub-acute infections. Since, however, several causes may be, and very frequently are, operative at the same time, etiological classification is impracticable for clinical purposes, and

a simple enumeration of the conditions in which ascites occurs, in the order of their importance, will be found more satisfactory:—

1. Cirrhosis of the Liver (Portal, or Laennec's Cirrhosis).—The ascites is mechanical, due to increased pressure in the portal vein, and in part also to the action of toxins on the peritoneal endothelium. Quite often cirrhosis is complicated by cardiac disease, more rarely by tuberculosis, which are then responsible for the ascites. In such cases the fluid accumulates early in the course of the affection, and numerous tapplings may be required. Ascites occurs in about 80 per cent. of cases of portal cirrhosis. In the biliary form (Hanot's cirrhosis) ascites occurs, if at all, at a late stage and is not a conspicuous feature; it is probably brought about by the development of portal as well as biliary cirrhosis.

(See also CIRRHOSIS OF LIVER, volume iii, p. 410.)

2. Cardiac Failure.—Ascites due to heart-failure is seen in its most typical form in tricuspid regurgitation complicating mitral disease, usually stenosis, and in advanced cases of myocarditis without valvular lesions. It is less frequent with aortic disease. As a rule, there is at the same time edema of the lower extremities and of the scrotum (absent in cirrhotic ascites), which is accordingly regarded as an important point in the differential diagnosis between cardiac and hepatic ascites. But it may happen that the backward pressure in a case of heart-failure affects the hepatic veins chiefly or exclusively, so that there is ascites without general edema,—a condition spoken of as “hepatic asystole,” and

closely resembling ordinary cirrhosis. Adherent pericardium is an occasional cause of passive effusion into the peritoneal cavity.

3. Chronic Peritonitis.—Under this head are included a number of conditions: simple diffuse or localized peritonitis; the form associated with malignant disease, and local peritonitis due to ovarian or uterine neoplasms, whether benign or malignant, in which large and frequently recurring accumulations of fluid in the peritoneal cavity are sometimes observed.

4. Bright's Disease.—The ascites is ascribed to the action of the nephritic toxin, as observed in the acute exacerbations of chronic parenchymatous nephritis, when it occurs early and as part of general anasarca. It may, however, be the result of cardiac dilatation and failure of compensation secondary to hypertrophy, as observed in the terminal stages of either parenchymatous or interstitial nephritis. It is probable that in every case of ascites occurring in the course of Bright's disease the cardiac factor predominates in the etiology. In early and in acute cases, edema is more marked in the extremities and in the tissues of the face, while ascites is quite frequently absent.

5. Diseases of the Liver other than Cirrhosis.—Perihepatitis, simple or syphilitic, and other syphilitic lesions of the liver, which may or may not be associated with chronic peritonitis. Ascites usually accompanies malignant tumors of the liver (carcinoma, sarcoma, echinococcus cyst). The neoplasm may press upon and obstruct the branches of the portal vein, or, projecting from the surface of the organ, set up a peritonitis with

effusion. Ascites results from obstruction of the portal vein by thrombosis, tumors of adjacent parts, or peritoneal adhesions.

6. Obstruction of the Inferior Vena Cava.—The causes are thrombosis, mediastinal tumors or adhesions, and the presence of *Filaria sanguinis hominis*.

7. Anemias.—Ascites is usually present to a moderate degree in leukemia with splenic enlargement. It is less frequent in secondary and in pernicious anemia, although it may occur in these and other diseases of the blood, and in malarial anemia with splenic enlargement.

The following systematic classification from Anders and Boston, "Text-book of Medical Diagnosis," may be said to have the merit of being comprehensive:—

(a) Diseases of the Peritoneum:—

Tuberculous peritonitis.
Carcinomatous peritonitis.
Non-suppurative acute peritonitis.
Peritoneal adhesions.
"Simple" chronic peritonitis.
Hydatid cysts in the peritoneal cavity.

(b) Obstruction to the Main Portal Vein:—

Non-suppurative thrombosis.
Peritoneal adhesions.
Aneurism.

(c) Tumors and Enlargements of Adjacent Organs:—

Liver.	Duodenum.
Pancreas.	Colon.
Kidney.	Suprarenal capsule.
Stomach.	Retropertitoneal sarcoma.

(d) Hepatic Causes:—

Atrophic cirrhosis.	Carcinoma.
Hypertrophic cirrhosis.	Sarcoma.
Perihepatitis.	Cyanotic liver with enlargement.
Syphilis.	Pulsating liver (chronic).
Hydatid disease.	

Any condition accompanied by extensive enlargement of the liver may, from

obstruction by torsion of or pressure on the portal vein, be accompanied by ascites.

(e) Obstruction of the Inferior Vena Cava:—

Thrombosis.	Chronic adhesive pleurisy.
Obstruction of thoracic duct.	Congenital cysts.
Rupture of thoracic duct.	Filariasis.
Rupture of the receptaculum chyli (chylous ascites).	Stenosis by chronic mediastinal adhesions.
	Occlusion by mediastinal growth.

(f) Chronic Valvular Heart Conditions usually accompanied by:—

Tricuspid regurgitation.	Aortic stenosis.
Mitral stenosis.	Aortic regurgitation.
Mitral regurgitation.	Adherent pericardium.
Myocarditis.	Fibroid heart.
Fatty degeneration.	Primary alcoholic heart.
Fatty infiltration.	
Fatty superposition.	

(g) Nephritis:—

In Bright's disease ascites may be caused in different ways:—
Part of a general dropsy.
Secondary to hypertrophy and dilatation of the heart, followed by failure of compensation and tricuspid regurgitation.

(h) Essential Anemias:—

Splenomedullary leukemia.	Aplastic anemia.
Lymphatic leukemia.	Splenic anemia.
Hodgkin's disease (rare).	Pernicious anemia.

TREATMENT.—The treatment of ascites, aside from the indications furnished by the basal disease, consists in **removal of the fluid by absorption or paracentesis**. Absorption is stimulated through **catharsis** and **diuresis**. **Mercurials**, as **calomel** or **blue mass**, followed by **saline purgatives**, **compound jalap powder**, and **elaterium** still maintain their popularity in cirrhotic cases. In cardiac ascites, **infusion of digitalis** in large doses, besides **free purgation**, should always be tried, especially in relatively

early cases. **Diuretics** are likely to prove disappointing until after paracentesis has been performed, when they may assist in preventing or at least retarding reaccumulation of fluid in cardiac cases. It is advised that **fluids be restricted** in the diet, but the effect on absorption is usually slight.

Whenever the effusion is so great as to cause the patient distress by its mechanical pressure, and particularly in cases of cirrhosis of the liver, **paracentesis** should be performed without delay. The procedure is comparatively simple and painless and, with the most ordinary care, entirely free from danger. The operation may have to be repeated a number of times at varying intervals in cirrhotic cases, and instances are reported in which, due probably to the formation of adhesions as a result of the repeated tapplings, the accumulation of fluid ultimately ceased and the patient survived for some time, free from the most distressing effect of his malady.

Technique of Paracentesis Abdominis.—The patient sits on the edge of a chair or, if too feeble, is propped up in bed in a sitting posture, and a roller bandage is applied snugly to the upper part of the abdomen, covering the umbilicus. The skin below the level of the umbilicus is cleansed in the usual manner with soap and water, alcohol or ether, or both, and painted with tincture of iodine. The puncture should be made in the median line, midway between symphysis and umbilicus, or on either side, midway between symphysis and anterior superior spine. A preliminary incision, half an inch in length, through the skin and subcutaneous fat, will minimize the pain of the pro-

cedure, especially in obese subjects. No local anesthetic is necessary. Before inserting the trocar, the operator must make sure, by percussion, that there is no loop of intestine in the way. A straight trocar, one-eighth of an inch (0.32 cm.) in diameter, is suitable, and the stylet usually has to be reinserted from time to time during the flow, to free the lumen of fragments of lymph. As the fluid is withdrawn, the abdominal bandage is tightened from time to time, in order to maintain a constant pressure on the abdominal contents and prevent collapse. Daily injections of **adrenalin chloride**—1 dram (4 Gm.) in 1 ounce (30 c.c.) of water—into the abdominal cavity, are recommended after paracentesis, to prevent or retard reaccumulation.

Talma devised an **operation** for the cure of ascites in cases of cirrhosis of the liver. The abdomen is opened and the peritoneum irritated by forcible rubbing with gauze, so as to set up a moderate degree of inflammation. The object of the procedure is to produce artificial peritoneal adhesions and thus promote collateral venous circulation between the general and the portal systems and relieve the pressure in the portal vein. Cures are obtained in about 37 per cent. of cases so treated, according to Talma.

When chronic ascites develops in hepatic cirrhosis, it is exceedingly unusual to observe permanent disappearance of the ascites after repeated paracentesis without any operative intervention such as **omentopexy**. If it does occur, it is probably due to the formation of omental adhesions and gradual improvement of collateral circulation. F. Parkes Weber (*Internat. Clin.*, i, 88, 1924).

ACUTE GENERAL PERITONITIS.

So-called general or diffuse peritonitis rarely involves the entire peritoneum. The term implies that the inflammation is not strictly localized and that the constitutional symptoms are severe. In practice two forms, **acute diffuse or general**, and **acute localized or circumscribed** peritonitis are distinguished.

SYMPTOMS.—While the symptomatology is largely determined by the primary cause, there is a well-characterized clinical picture of acute peritonitis which has been handed down to us by the early Greek writers. In an ordinary case of rapidly spreading perforative peritonitis the onset is sudden, with intense pain at the site of the infected focus, rapidly becoming general. The abdomen, at first rigid and retracted, becomes distended, tender, and painful; the pulse and temperature curves rise together; the character of the pulse is small, hard and "thready," while the blood-pressure may be high. The degree of pyrexia is variable. There is a characteristic expression on the patient's countenance: the pinched and drawn features, the skin covered with cold sweat, and the look of anxiety in the hollow eyes make up the well-known picture of the Hippocratic facies. The breathing is shallow, of the costal type, due to pain-inhibition; the tongue is dry, and there is constant thirst. The bowels are constipated, as peristaltic paralysis is a marked and early feature; the urine scanty, high-colored, albuminous. To ease the severity of the pain, which is greatly increased by movement, the legs are flexed at the knees and drawn up on the belly. As the

abdominal distention increases, vomiting sets in, fluid begins to collect in the peritoneal cavity, and the general signs of severe toxemia appear in the face and attitude; the pulse weakens and becomes more rapid, sometimes attaining 160 or 170 beats in the minute; the skin is cold and clammy, although the temperature continues to rise; cyanosis develops, and the extremities become cold. Death results from heart-failure, pulmonary edema, or aspiration of fluid into the lungs. The mind usually remains clear until near the end.

Series of 28 cases of "primary" peritonitis. Of 10 cases in which no focal disorder or accompanying disease could be discerned, 5 had pain and vomiting at first. Of the 18 accompanied or preceded by other sites of infection, only 4 noted pain as an abdominal symptom, and but 5 vomited. There was an early rise of temperature with rapidly developing septic curve. A low temperature occurred in the few adults who had no accompanying disease and who soon died. Leukocytosis was almost invariable, the 1 exception being a leukopenia in influenza. Diarrhea was infrequent. In 20 cases there was abdominal distention as chief terminal symptom. Zierold (Ann. of Surg., Mar., 1924).

Variations from this classical picture, of course, occur and are best described in connection with the individual causal conditions, typhoid perforation, appendicitis, and the like.

Pain is a constant symptom except rarely in the presence of typhoid perforation,—in which condition the entire absence of pain has, in the writer's experience (in negroes), caused failure of timely diagnosis, though the patient's mind was clear,—and in greatly exhausted or stuporous patients. It is constant, progressive, intolerable, aggravated by all move-

ments even of the diaphragm, and inhibits the respiratory movements of the abdomen. The distribution is general and shows no constant relation to the seat of the lesion.

Tympanites usually develops in from twenty-four to forty-eight hours. Liver dullness is obliterated; the percussion note is high-pitched over the vault of the abdomen, fading into dullness at the flanks when the fluid has accumulated. Absence of gurgling on account of intestinal paralysis is a significant symptom.

Vomiting is due to the same cause and is fairly constant unless there is diarrhea; it may at last become fecal even in the absence of obstruction. Hiccough is a distressing symptom, usually occurring late and obstinately refractory to treatment.

The respiration, as stated, is of the costal type, shallow and hurried, 40 to 50 per minute, and accompanied by cyanotic discoloration of the tip of the nose, ears, and extremities.

The pulse is accelerated, regular, at first 100 to 120 per minute; at last becoming more and more rapid and impossible to count. It is small, wiry or thready, and the tension is high—160 to 170 mm.—until near the end, when the blood-pressure falls.

The temperature is variable, with a general tendency to hyperpyrexia, but exhibiting no constant relation to the severity of the toxemia. Even the sudden fall in temperature which precedes the onset of peritonitis from typhoid perforation is not a constant phenomenon. In general, the temperature is of little diagnostic value.

There is a moderate reduction of the erythrocytes, said to be due to concentration of the blood. Leuco-

cytosis of the polymorphonuclear type is the rule, but cannot be depended upon. In severe cases the leucocytes are not increased, and there may even be leucopenia. Blood-cultures may show the causal organism, but are usually sterile.

The urine is scanty and high-colored, and usually contains a small quantity of albumin, diacetic acid and acetone, and indican. Retention of urine is sometimes present.

The following special forms of acute peritonitis require separate mention:—

Puerperal Peritonitis.—Puerperal peritonitis is due, in the majority of cases, either to *Streptococcus pyogenes* or to *Gonococcus*, the former type being by far the more virulent. The colon bacillus, in this variety of the disease, is less important as a causative agent. The infection enters through solutions in the continuity of the genital tract, after labor or a criminal abortion; and extension, which is exceedingly rapid, takes place through the lymphatics. The infection progresses rapidly, and early leads to a grave toxemia. Meteorism is marked, being increased by the relaxed condition of the abdominal walls following labor. Diarrhea and vomiting are commonly present. An early clinical sign is a change in the odor of the lochial discharges. The tendency of puerperal peritonitis is to general septicemia and a fatal issue. Complications are phlebothrombosis and arthritis.

Pneumococcal Peritonitis.—The disease is rare and occurs more often in children than in adults. It is not, as a rule, secondary to pneumonia, but pneumococcal lesions may be present elsewhere than in the peri-

toneum. Thus, there may be an accompanying pneumonia or bronchopneumonia, empyema, otitis media, or pericarditis due to a pneumococcal infection. Rarely the infection reaches the peritoneal cavity from a pleurisy, through the lymphatics of the diaphragm. Usually the disease is "primary," *i.e.*, the peritonitis is the chief or only focus of infection, which is believed to have been conveyed through the blood- or lymph- channels (from a focus in the thorax or in the throat or ear), through the intestines (appendicitis), or through the Fallopian tubes. Both a diffuse and an encysted form are described. The pus resembles that of an empyema—fibrinous, greenish yellow, and odorless. A **pneumococcal polyorrhomenitis** involving pleuræ and pericardium as well as the peritoneum has been described in young children.

The histories of 9 cases showed 2 clinical types of pneumococcic peritonitis: (1) that clearly secondary to a pneumonia or empyema, and (2) that apparently primary or idiopathic. The onset of the first may be unattended by any definite symptoms. The onset of the second group is characterized by symptoms so acute as to immediately overwhelm the patient. P. W. Beaven (Amer. Jour. Dis. Children, Oct., 1920).

The onset is acute, with vomiting and pain referred to the lower abdomen, simulating appendicitis, for which the condition is often mistaken in the early stage. Diarrhea sets in, and the signs of peritonitis develop.

The symptoms are relatively mild, resembling those of tuberculous peritonitis rather than of the more acute forms. A prolonged stage usually follows, with the formation of adhesions resulting in an encysted peritonitis. The abscess or **abscesses** may

discharge spontaneously through the bowel or vagina. Rarely the temperature falls by crisis. The prognosis is fairly good in encapsulated cases that are **opened and drained**.

The sudden onset, often with a chill, is followed by an extremely high temperature with a high leucocyte count. Diarrhea is a conspicuous symptom and peritonitis with diarrhea always suggests the pneumococcus. There is lack of localizing symptoms, as compared with the perforative type of peritonitis, and the abdomen is described as having a "doughy" feel. There is marked toxemia and the patient seems far more ill than the abdominal symptoms would indicate. Bacteremia is generally present and blood cultures should always be made. Syms (Annals of Surgery, lxvii, 263, 1918).

Gonococcal Peritonitis.—A mild form occurring almost exclusively in women; very rarely the peritoneum may become infected in male patients through the lymphatics of the spermatic cord. The course is usually short and sharp, abating in two or three days. The exudate is fibrinous and contains only a little pus or serum. There is no distention or rigidity of the abdomen. The *diagnosis* is based on the pain in the lower abdomen and the presence of a gonorrheal discharge. Operation is not indicated, and the prognosis is good except in young children.

Peritonitis in Infants.—The symptoms of peritonitis in children are more obscure than in adults; and the condition is, therefore, more frequently overlooked in its early stage. The sudden onset, with vomiting, fever, distention and tympany of the abdomen, rapid pulse and hurried respiration, is not characteristic of any especial type of infection. The

acute form is usually fatal within a few days. The causes of peritonitis in infants are intestinal obstruction, volvulus, intussusception, strangulation of the intestines due to any cause (such as congenital atresia or adhesions), and occasionally appendicitis. Peritonitis may develop secondarily from an empyema. A septic type of peritonitis occurs in newborn infants, the infection being derived from the mother through the umbilical cord. The causal micro-organism in these cases is usually a streptococcus. Recovery is rare. It is believed that peritonitis in fetal life is the cause of congenital malformations, atresia of the intestines, imperforate anus, etc.

Case of purulent peritonitis in an infant 21 days old. The infection was probably umbilical. In a second case the infant was nearly 5 months old and the peritonitis was evidently secondary to enterocolitis. A third infant only 3 weeks old was taken suddenly, and necropsy showed stenosis in the small intestine as the only probable cause. All the children were breast fed, but the first showed signs of inherited syphilis. Hydrocele is frequent in such cases, with edema of the scrotum, as an early sign of the peritonitis. Acuña and Casaubon *Frensa Med. Argent.*, Sept. 10, 1918).

Occasionally the process may become localized, with the formation of adhesions and abscesses. Unless this is the case, surgery in general streptococcic peritonitis is useless.

DIAGNOSIS.—Peritonitis may be simulated by *colic* due to flatulence and constipation, lead poisoning, gall-stones or renal calculus. There is, however, no real tenderness and the abdominal pain is relieved by pressure. Vomiting is rare except with the passing of calculi. When

fever is present from the beginning of the attack, peritonitis should be suspected.

A sympathetic peritoneal infection manifested in acute serous peritonitis and simulating acute appendicitis can be induced by intestinal affections. Pathologic findings fail to substantiate the suspected appendicitis. Gurewitsch (*Zent. f. Chir.*, Apr. 4, 1925).

Hysteria, giving rise to the phenomena of "peritonism," can be excluded by the usual means. There is usually a history of hysteria and possibly of similar previous attacks. Examination shows cutaneous hyperesthesia, but no real pain, and the symptoms may be made to disappear by distracting the patient's attention.

The relation between peritonitis and *mechanical obstruction of the bowels* must be kept in mind in making a diagnosis. Obstruction is followed in a few days by peritonitis and, on the other hand, peritonitis leads to obstinate constipation which practically amounts to obstruction by paralyzing peristalsis. In obstruction there is absolute stoppage of both feces and flatus; in peritonitis an enema is usually followed by the passage of wind. There is less tendency to fever in obstruction, and the pulse is of good volume and not markedly accelerated; peristalsis persists or is even increased; pain is colicky, not continuous, and there are less tenderness and rigidity; fecal vomiting occurs early; finally, there is no evidence of fluid in the abdomen or of inflammation in the various organs.

From *acute hemorrhagic pancreatitis* the diagnosis may be extremely difficult. The points to be remembered are the great severity of the symp-

toms from the onset, the board-like hardness of the abdominal wall in the epigastric region, and the extreme prostration. The pulse is very feeble from the outset and the temperature not very high. Fat-necrosis is found on opening the abdomen.

The symptoms which may aid in differentiating *retroperitoneal* from intraperitoneal inflammation are, according to Sprengel: Generalized deep tenderness and absence of superficial tenderness and pain; absence of peritoneal symptoms, with the rapid development of deep-seated symptoms in the first few days. Secondary peritonitis often develops soon after retroperitonitis, so that the picture is often obscure.

Sgambati's test for peritonitis carried out in 600 patients. To 6 to 8 c.c. of albumin-free urine are carefully added, without mixing, 2 to 3 c.c. of pure nitric acid. At the plane of contact a bluish gray color, due to indican, appears. After a time the liquid is shaken with 2 or 3 c.c. of chloroform, which, where the test is positive, quickly changes from a blue to a red color. This second phase of the reaction is deemed useful in the diagnosis of pyogenic involvement of the peritoneum, even when slight. Giordano (Rif. med., Feb. 25, 1924).

Rupture of an ectopic gestation sac, and certain grave and rare accidents in the abdominal cavity, such as *rupture of an aneurism, embolism of the superior mesenteric artery and hemorrhage into the mesentery, or twisting of the pedicle of an ovarian cyst*, should be remembered in the differential diagnosis. When any of these conditions is suspected and the diagnosis is not clear, the abdomen should be opened.

In peritonitis from *rupture of a pyosalpinx* the first symptoms, as described by Lamouroux, are insidious. There is first a little pain in the abdomen; then vomiting follows, the temperature rises, and the pulse increases. The abdomen is soft but tender. Of 47 cases, prompt laparotomy saved 27. The 31

cases in which no operation was attempted all died. Brickner emphasizes as of diagnostic value in these cases a history of repeated attacks of pain for a week or so before the attack that marks the rupture. These attacks suggest impending rupture and the need of operation, while in a case of acute purulent peritonitis of unknown origin they suggest a ruptured pus-tube.

Case diagnosed as *fulminant menstrual peritonitis* in a girl of 14. She had been menstruating for 3 days before her death. About 12 hours after an athletic contest, she developed intense abdominal pain, toxic state, and coma, with death 12 hours after the onset. Autopsy showed no pathologic cause, and the condition is ascribed to patency of the cervix during menstruation and suction of the vaginal contents through the uterus and tubes into the peritoneal cavity as a result of negative intra-abdominal pressure during the patient's athletic activities. Adami (Jour. Obst. and Gyn. of Brit. Emp., xxix, 104, 1922).

The danger of mistaking a thoracic for an abdominal condition at the beginning of the attack has been pointed out by most systematic writers on diagnosis, but should be emphasized once more in this connection. In children, especially, a *pleurisy* or a *lobar pneumonia* may be missed at first when pain in the abdomen is the only symptom complained of. A study of the temperature, pulse, respiration ratio, and careful, repeated physical examination of the chest will always suffice to guard against this error, providing the possibility of pneumonia is in the examiner's mind. In any doubtful case operation should be postponed, as the appearance of characteristic physical signs is often delayed, especially in cases of central pneumonia.

Typhoidal perforation, according to Hawkes, is often only the chance termination of an inflammatory condition which should have been recognized long before. Muscular rigidity

is the only constant early sign of peritonitis in typhoid. The patient should be examined in a warm room, in the horizontal posture with the knees drawn up. The presence of rigidity is to be determined by a succession of short, delicate "pushes" with the finger-tips, the finger-joints being kept flexed.

In view of the difficulties attending the diagnosis in infants, the writer resorts, for the detection of peritonitis and peritoneal transudates, to puncture with a capillary tube. Through the shaft of a metal trocar cannula $\frac{1}{2}$ inch long and of 17-gauge bore, he inserts glass tubing, which he then cuts off so that it protrudes 1 or 2 mm. from the tip. Upon introduction through the abdominal wall, a sudden release of pressure signifies entrance into the peritoneal cavity. The trocar is then removed and the capillary tube inserted as far as it will go. It is advisable to wait a few minutes and turn the needle in various directions before concluding that there is no fluid. No complications followed in over 100 punctures. In a number of cases the procedure proved of service in establishing the diagnosis. It has also revealed that there may be free fluid in the peritoneal cavity in rickets and marasmus. Denzer (Arch. of Ped., Nov., 1922).

PATHOLOGY.—Acute Circumscribed Peritonitis.—This form is seen most frequently in the pelvis and in the appendiceal region. The peritoneal vessels at first are injected, and the membrane loses its normal luster with the loss of endothelial cells. The exudate, at first serous, soon becomes fibrinous and then fibropurulent as the abscess localizes. The organisms most commonly found are *Bacillus coli communis* and staphylococci. The process ends in spontaneous external or internal rupture; inspissation of the pus, caseation or even calcification, or in absorption and the formation of dense adhesions.

Acute General Peritonitis.—This may result directly from perforation of an infected viscus, or may be secondary to the localized form when the abscess ruptures. The so-called primary or hematogenous form has been described under ETIOLOGY. The initial changes are the same as in the circumscribed variety. The character of the exudate varies with the type and severity of the case. There may be an abundant serous outpouring, a veritable acute inflammatory ascites, in severe, toxic cases; or the exudate may be small in quantity, collected in pockets formed by the dense adhesions which characterize the fibrinoplastic cases, the intestines and omentum being matted together in a dense mass. The exudate consists of yellow pus from the action of pyogenic bacteria, or it may be brownish gray, putrescent in severe cases with secondary necrotic changes, as in strangulation of the intestine with gangrene, or in severe puerperal sepsis. The fluid is often hemorrhagic, particularly in the presence of passive congestion. In rapidly fatal cases very little pathological change may be noted.

ETIOLOGY.—Theoretically aseptic peritonitis, due to chemical irritants or bacterial toxins, exists; but for practical purposes all cases of peritonitis may be regarded as caused by bacterial infection. The term "primary peritonitis" is still employed to designate inflammation of the peritoneum without demonstrable localized focus in an abdominal viscus. Peritonitis is said to be "hematogenous" when it occurs in the course of a general infection without discoverable cause other than supposed infection through the blood- or lymph-

paths. The source of infection in such cases cannot be discovered. True primary inflammation of the peritoneum is unknown. These forms are diffuse from the beginning, in contradistinction to those in which a general peritonitis results from the breaking down of adhesions surrounding a primarily localized focus. The most frequent bacterial causes are: *Bacillus coli communis*, *Staphylococcus albus* and *aureus*, *Streptococcus*, and sometimes *Pneumococcus*, in peritonitis resulting from perforation of an abdominal viscus, appendix, stomach, or small intestine. Puerperal peritonitis is usually due to *Streptococcus*. Occasional causes are: *Pneumococcus* ("hematogenous peritonitis"); *Gonococcus* (localized genital type in females); *Bacillus of Friedländer*; *Bacillus pyocyaneus*; *Bacillus capsulatus aerogenes*, and, rarely, *Bacillus tuberculosis*, and possibly *Bacillus typhosus* (Chantemesse's typhoid peritonitis).

Infection may occur (a) from without—trauma, operation; (b) by continuity through perforation of an infected hollow viscus (the most frequent mode of infection), or rupture of an abscess in or around a solid organ, such as a perinephric abscess; (c) by continuity without solution of continuity through the wall of hollow, tubular structures—intestines, Fallopian tubes; (d) by way of the blood- and lymph-channels, as in so-called "primary," "hematogenous" peritonitis in the course of general infections (pneumonia, erysipelas, typhoid fever), puerperal sepsis, pneumococcal peritonitis, cancer, late nephritis, and the like. It must be remembered that the source of infection may be difficult

to find, and the term "cryptogenetic infection" in such cases becomes appropriate. The most frequent bacterial causes are *Bacillus coli communis* and the pyogenic germs.

Case suspected of acute appendicitis, but with the appendix found normal at operation. Fever continued, and ultimately panhysterectomy revealed tuberculosis of both adnexa. Such cases of acute peritonitis of tuberculous adnexal origin are not uncommon, and are marked by a good general condition and pulse, and frequent retention of the appetite. Slightly tender, hard, deep masses may be palpable. The fever may continue for weeks, and the general state gradually becomes impaired. Some cases simulate instead a gonococcal adnexitis. Ricard and Comte (Gynéc. et obst., July, 1925).

PROGNOSIS.—The mortality of acute general peritonitis is high, and the prognosis is more grave in children and aged subjects than in the young and middle-aged. A persistently low temperature; very rapid, thready pulse; distention of the abdomen, and absence of leucocytosis are bad prognostic signs. Perforative peritonitis almost always ends fatally unless operation is possible, and the abdomen is opened within twelve hours of the onset of symptoms. The most virulent organisms are *Streptococcus pyogenes* and *Bacillus pyocyaneus*; next in inverse order of severity are *Bacillus coli communis*, *Pneumococcus*, *Gonococcus*, and *Staphylococcus albus*. Traumatic perforation (bullet and stab wounds) gives a better prognosis than perforation due to disease (typhoid ulcer, appendicitis). The higher the perforation in the alimentary tract, the better the prognosis, because in both cases colon bacilli are less numerous and of lower virulence.

Study of the factors influencing mortality of peritonitis in 63 recent cases of appendicitis, complicated by local or diffuse peritonitis, with the following result: Not purged before admission, 7; recovered, 7; died, 0. Opiates before admission, 22; recovered, 18; died, 4. No opiates before admission, 41; recovered, 38; died, 3. Pfeiffer (*Penna. Med. Jour.*, xix, 604, 1916).

TREATMENT.—Acute General Peritonitis.—Aside from the strict observance of aseptic precautions in all surgical procedures in the abdominal cavity, certain special procedures are sometimes employed by surgeons to limit the risk of infecting the peritoneal cavity. **Preliminary injection** into the peritoneal cavity, twelve hours before operation, of **horse serum** or **nuclein** to induce leucocytosis, has been recommended; or, the **injection of salt solution with adrenalin**, before or after operation, in the hope of preventing absorption through the lymphatics, may be tried. The utility of these measures remains to be demonstrated.

According to Kaczyinsky, intramuscular injections of quinine prevent peritoneal infection, and may be advantageously used after appendectomies and operations for pelvic disease with suppuration. A watery solution of **quinine bisulphate**, 1 to 11, is used, 3 c.c. (45 minims) being injected into the muscles of the thigh. Injections are made 3 or 4 times daily, sometimes being continued until the fifth day after operation.

The writer endeavors to prevent post-operative peritonitis in the following way: After incising he allows a certain quantity of **camphorated oil** to flow into the abdomen, then places the patient in the operating position, and, after covering the ventral opening, allows a dozen or so inspirations, protective compresses being placed to absorb the excess of oily fluid. Camphorated oil tends to prevent obstruction of the lymphatic channels,

checks agglutination of bowel loops, allows prolonged drainage, and plays an important rôle as heart tonic. Three hundred cubic centimeters of 1 to 100 strength can readily be injected. This procedure yielded good results. Chaton (*Presse méd.*, p. 395, 1916).

Prophylactic introduction of 50 to 100 c.c. (1½ to 3¼ ounces) of **ether** into Douglas's pouch and over the neighboring bowels to protect against extension of peritonitis in 15 cases of more or less severe bacterial invasion of the lower abdomen. Thirteen were severe cases of pelvic peritonitis, some septic, some gonorrheal. All recovered. Shock sometimes followed, but this can be avoided by not closing the abdomen too soon after introducing the ether. Sigwart (*Münch. med. Woch.*, Apr. 7, 1922).

Surgical Treatment.—This offers practically the only hope of saving the patient's life. Operation must be performed early, within twelve, or, at the latest, twenty-four hours of the perforation.

The writer urges abstention from purgation in acute abdominal conditions; **gastric lavage** is the proper procedure. In a diffuse appendiceal peritonitis with peristalsis absent, **operation** after the first 36 or 48 hours from onset of the peritoneal inflammation with no evidence of a localizing point, is in the majority of cases unwise. Operation at an indiscreet time liberates toxins which cause death. With localized tenderness due to an inflamed, gangrenous or perforated appendix, or where the symptoms indicate perforation of one of the large viscera or intestinal obstruction, immediate operation is indicated. Deaver (*N. Y. Med. Jour.*, Sept. 7, 1921).

The objects of operation are: (1) **To remove the cause of infection**—the inflammatory focus,—**close or excise a ruptured or ulcerated viscus** (typhoid ulcer, intestinal obstruction), and (2), in cases of non-perforative peritonitis,

to **open and drain localized abscesses**. The manipulations must be performed rapidly and with a minimum of traumatism to the abdominal contents.

Puerperal diffuse peritonitis is considered by the writer less dangerous than is generally thought. He makes a **median incision** from umbilicus to symphysis, introduces several liters of **warm saline solution**, taking up the excess with gauze compresses, and removes the focus of infection, not by hysterectomy, but by briefer procedures such as **removal of a ruptured ovary**, **suture of a perforation**, or **extraperitoneal opening of a retroperitoneal phlegmon** through a separate incision. For marked colon distention he **punctures** for release of gas and resutures. To overcome disturbances of peritoneal circulation he uses **intravenous saline with adrenalin**, together with **digalen**, **strophanthin**, and **caffeine**. Latzko (Wien. klin. Woch., Sept. 1, 1921).

Ten cases of an idiopathic acute serous peritonitis with fever, in which laparotomy was done for acute appendicitis but nothing found except an abundant serous effusion. All cases promptly recovered after the **laparotomy**. Melchior (Acta chir. Scand., June 14, 1922).

Drainage advocated in accordance with the focus and extent of infection; **morphine** at frequent intervals, but not beyond a reduction of respiration to 14 per minute; **large hot stupes** or an **ice-bag**; **Fowler's position**, and hypodermoclysis or intravenous injection of 4000 c.c. or more of **saline solution** every 24 hours. D. K. Bacon (Jour. Amer. Med. Assoc., Nov. 11, 1922).

General summary of the procedures now approved in acute general septic peritonitis: When peritonitis is suspected, give nothing by mouth and no cathartics. Operate as early as possible to **remove the source of infection**. Do no more than is necessary for this purpose and do not damage the peritoneum. In early cases do not remove the exudate (except coarse material

from a stomach perforation or rent in the colon) and do not drain. Place the patient in the **Fowler position**. Overcome toxemia by **subcutaneous** and **rectal infusions of normal saline**. Overcome dehydration by **rectal use of tap water** or 5 per cent. **glucose** and 5 per cent. **sodium bicarbonate solutions**. Apply heat over the abdomen by **thermophore**. Support the circulation by **cardiac stimulation**. If necessary, give **morphine** to quiet the patient and control peristalsis. In *gonococcic peritonitis* associated with tubal infection, operation is contraindicated. In operating, the principles are, small incision; gentle removal of pus and exudate, keeping the bowels within the abdomen as much as possible; **drainage** only in late cases or with a walled-off abscess, and brief operation. Behle (Northw. Med., Oct., 1922).

After the primary focus has been found and dealt with some surgeons advocate free flushing of peritoneum; others, sponging; others, only **drainage**. Moynihan makes a second incision in what seems to be the best point for free drainage. Others make from 3 to 5 incisions, each large enough to take a split rubber tube. Wilensky (Prog. Med., June, 1926).

Certain auxiliary measures are important, among which may be mentioned, first of all, the so-called **Ochsner conservative treatment**, consisting in **posture**, the application of **cold to the abdomen**, and **enteroclysis**. The patient is placed in bed, in a modified sitting posture known as **Fowler's position**, and enteroclysis is administered two or three times in the twenty-four hours, or the salt solution may be given by the Murphy drop method. If the saline mixture is not absorbed by the bowel, or if a more intensive action is desired, it may be administered by the hypodermic route or, in emergency cases, intravenously. The temperature of the

water should be somewhat above body heat, and only small quantities should be introduced into the circulatory system at a time—not more than 10 ounces (300 c.c.). The introduction of this amount should occupy about twenty minutes. Equally good results are obtained with a moderate as with a large quantity of salt solution, with a minimum of danger to the cardiovascular system.

To prevent or inhibit peritonitis the following measures were recommended by A. J. Ochsner: 1. **Gastric lavage** immediately, where there is nausea or gaseous distention (except where peritonitis follows perforation of stomach or duodenum). 2. **Rectal instillation of normal saline** by the drop method, continuing for 1 to 2 hours, then interrupting, for 2 hours. Where this method is not practicable, give 500 to 1000 c.c. (1 to 2 pints) of **saline solution subcutaneously**, repeating as required to relieve thirst and keep the vessels filled. 3. **Fowler position**. 4. **Large, hot, moist dressing of saturated boric acid solution and alcohol** in equal parts applied to the **abdomen**. 5. Give **no carthartics or food by mouth**; even **prohibit water** till patient is on the way to recovery. **Feed by enemata** consisting of 1 ounce (30 c.c.) of concentrated liquid food in 3 ounces (90 c.c.) of normal saline; add 10 to 50 drops of **deodorized tincture of opium** to each feeding till no longer painful. Administer slowly every 3 or 4 hours through a rubber catheter introduced not more than 3 inches.

In dogs, the author observed 100 per cent. fatality in untreated experimental peritonitis, 83.33 per cent. in dogs given **ether lavage** after 24 hours, 2.5 per cent. in dogs given both ether lavage and **enterostomy**, and 100 per cent. in dogs similarly treated but only after 48 hours. Marchetti (Rif. med., July 24, 1922).

The writer had been using camphorated oil in peritonitis, reducing the mortality somewhat; in several instances, however, abscesses developed in Douglas's pouch. Subsequently he used ether instead, injecting, in cases of *perforative peritonitis*, from 80 to

100 Gm. (4 to 5 fluidounces) of **ether** into the abdominal cavity. In 200 cases no harmful effects were observed, and the mortality was reduced over $\frac{1}{2}$, to 28 or 30 per cent. The effect of ether is often instantaneous. The facial expression of the patient changes; the color improves and the pulse grows stronger. Of late he has been trying a **mixture of camphor and ether**, but cannot state as yet whether this will effect a further reduction of mortality. B. von Lukö (Zent. f. Chir., May 5, 1923).

A fatal outcome from the injection of **ether** in diffuse peritonitis was observed by the author, after he had used the injections with favorable results in about 100 cases. The fatality was in a young woman, aged 21, with appendiceal peritonitis. He has lost confidence in the absolute harmlessness of ether injections, and will proceed more cautiously in feeble individuals and children. He holds, nevertheless, that ether exerts often an astonishingly favorable effect in almost hopeless cases. He introduces ordinarily from 80 to 100 Gm. of ether. C. Weber (Zent. f. Chir., July 28, 1923).

Ether takes up fats and fatty acids from the pus in peritonitis. After it has been allowed to evaporate, the peritoneum is found covered with the combination thus formed, which has an antiseptic action, and continues the disinfecting action of the ether. The hyperemia induced by the ether is also favorable. Consequently, the author considers the use of **ether** in large amounts rational in the treatment of purulent peritonitis. Küstner (Deut. med. Woch., Dec. 21, 1923).

Supplementary detoxicating procedures such as **jejunostomy** and **lymphaticostomy** are advocated by some surgeons in selected cases.

In cases complicated by profound toxemia, recurrent vomiting, and an absolutely quiet abdomen, continued drainage of the bowel contents by **intestinal intubation** has many times proven life-saving. A $\frac{1}{4}$ inch non-collapsible rubber tube is used, with per-

forations at intervals of $\frac{3}{4}$ to 1 inch for 5 inches above the tip. This is passed through the amputated stump of the appendix and ileocecal valve until the last perforation is within the cecum. The tube is anchored with a pursestring suture and the cecum attached to the anterior abdominal wall, with the omentum interposed between the gut and peritoneum. Peritoneal drainage is obtained through the opposite angle of the wound. A small catheter may be passed through the intestinal tube for the injection of irrigants or nourishment. A. N. Collins (Minn. Med., Jan., 1921).

As a result of careful experiments, the writer holds that there occurs a fatal absorption of pathogenic substances through the thoracic duct in suppurative peritonitis. The occurrence of a fatal absorption through the subperitoneal capillaries or through the diaphragmatic lymphatics to the anterior mediastinal lymphatics and the right lymphatic duct was thought to be disproved. The experiments showed, moreover, that when a fatal absorption is overcome by **lymphaticostomy**, the peritoneal cavity is capable of looking after such a formidable structure as a necrotic appendix. Costain (Surg., Gyn. and Obst., Mar., 1923).

Death in acute septic peritonitis is not in most cases due to absorption of the products of the peritoneal inflammation, but to intestinal toxemia secondary to paresis of the inflamed intestine. By performing a **jejunostomy**, a number of apparently hopeless cases were saved. The writer urges this procedure in the diffuse general suppurative peritonitis of the lower abdomen associated with appendicitis, tubal disease, and other septic pelvic conditions. To obviate marked loss of fluid as well as a second operation for closure, he proceeds after the manner of a Witzel gastrostomy: A No. 12 soft rubber catheter is inserted into the intestinal lumen through a small puncture and fixed by a single catgut stitch. The next couple of inches of catheter are buried in the intestinal

wall by a continuous infolding suture, and the proximal end is passed through a hole in the omentum before being brought out through the abdominal wall. The catheter drains through a long tube into a bottle beside the bed. At frequent intervals 6 to 10 ounces (180 to 360 c.c.) of **sodium bicarbonate** solution are run into the intestine, the end of the tube then being immediately depressed and replaced in the receptacle. After a time, when the outflow from the tube ceases to be the dark foul-smelling fluid characteristic of intestinal obstruction, the tube can be clamped in the intervals of being used as a means of introducing a **soda and glucose solution**. In a week or 10 days the stitch fixing the catheter is absorbed and the catheter is then removed; no leakage follows. Seton Pringle (Lancet, Apr. 25, 1925).

Among 16 cases of diffuse peritonitis in which **lymphaticostomy** was instituted, the mortality was reduced by 30 to 40 per cent. Costain (N. Y. State Jour. of Med., Mar. 15, 1926).

The question of **postoperative irrigation** is an important one. Most surgeons advise against it, on the ground that it adds to the risk of further spreading of the infection and **interferes** with the action of the phagocytosis and with the absorptive power of the lymphatics in the peritoneal cavity. It should be reserved for special cases.

Three cases in which the accumulation of gases in the abdominal cavity was such as to threaten life. They had developed in the course of gangrene of the abdominal walls, but the pulse remained good. An **incision** such as that for enterostomy released an enormous amount of odorless gas. The bowel seemed to be normal although compressed nearly flat. Stegemann (Arch. f. klin. Chir., cxxiii, 523, 1923).

The treatment of peritonitis involving the pelvic and small intestine is extremely simple. The germs concerned can be destroyed only by the toxins

that they themselves create; their death is assured, given sufficient time. The procedure advised in general peritonitis is merely to pass a small, soft **rubber tube** or an **accordion drain** nearly, but not quite, to the bottom of the pelvis (not using any gauze), place the patient in the **Fowler position** and give **saline solution** by rectum or intravenously if necessary, and withhold food until the bowels move. The tube is not for drainage, but to allow enough fluids to escape to relieve the intra-abdominal tension and thus facilitate circulation through the blood and lymph vessels. All patients with general peritonitis treated in this way will recover if the treatment is instituted before paralytic obstruction is developed. G. E. Armstrong (Surg., Gyn. and Obst., June, 1925).

Medical Treatment.—The medical treatment of peritonitis has practically been covered in the foregoing paragraphs, and may be summarized as purely expectant. The patient is placed in the **Fowler position** to encourage drainage—or, rather, to counteract, if possible, the extension of the infection toward the diaphragm. During the acute stage, **no food, nor even fluid**, should be given by the mouth. **Purgatives** are **absolutely contraindicated**. Thirst is relieved by **enteroclysis**; and what **nourishment** is to be given must also be administered by way of the **rectum**. Severe vomiting may be controlled by **lavage**. Tympanites is an indication for a **turpentine stupe** and a **medicated or oil enema**. The introduction of the **rectal tube** alone is sometimes followed by the escape of flatus and the relief of the symptom. **Opium** is **absolutely contraindicated**, so long as the **diagnosis remains in doubt**; and, even after the latter is established, it should be given only to relieve extreme pain, as it adds to the danger

of intestinal paralysis. The pain should be controlled by local applications, especially the **ice-bag** in adults. If the patient goes into collapse, however, **external warmth** is required. Crile has recommended the intravenous administration of a 1:50,000 **adrenalin solution with atropine**, and has reported occasional successes from its use. The procedure is, however, not free from danger, as sudden death has occurred from pulmonary edema as the result of it.

It has been strongly advised by R. H. Fowler that suspected cases of acute appendicitis be placed and maintained in the **Fowler position**. Early institution of postural drainage is of greater benefit to the patient in preventing septic material from reaching the diaphragmatic peritoneum than in preventing further absorption after this area is once involved. Ambulance cases of appendicitis should be brought to the hospital in the sitting posture. The trunk should be elevated during the operation. The cart which transfers the patient to and from the bed should be elevated at the head. The manner of instituting postural drainage matters but little, provided that the pelvis is sufficiently low for gravitation to take place, and the patient is comfortable. It has been shown (Buxton) that there is a rush of bacteria toward the diaphragmatic lymphatics of the peritoneum as soon as infection comes in contact with it. Postural drainage, to be effectual in these cases, must, therefore, be maintained all the time.

In infants the treatment consists in administration of **castor oil** and, after the intestinal tract has been cleared, the symptomatic use of an opiate (**paregoric**), to control the pain. Children do not bear cold applications to the abdomen, but react better to the application of heat. The child's strength should be maintained by **careful feeding** with **brandy** and **concentrated prepared foods**, such as **liquid peptonoids**, **peptomangan**, etc.

In acute diffuse peritonitis in children both **stomach drainage** with an indwelling Rehfuß tube and an **enterostomy** are required. In the case reported the stomach drainage had the following 4 advantageous effects: (1) It soothed the child by allowing it to drink all the cold fluids desired (3 quarts daily of orangeade, lemonade, water, ice cream, etc.), the fluids draining out through the Rehfuß tube as fast as swallowed; (2) it arrested the fecal vomiting, with its exhausting exertion; (3) it washed out the intestinal toxins from the stomach (about 3 quarts daily); (4) it combated the high fever by the cold fluids. If the tube is not well borne, even a **gastrostomy** should be considered. The high enterostomy is done both for drainage and for nourishment. Five per cent. **glucose solution** runs in gradually through this enterostomy from a funnel hung about 10 inches above the abdomen. In the author's case, 48 ounces of this solution were thus run in 4 days, and had a striking effect in strengthening the child's pulse and apparently saving the child's life. Drainage from the enterostomy can be alternated with nourishment. Tranquility should be maintained by generous subcutaneous doses of **codeine phosphate**. Tolerance of the indwelling tube may be facilitated, if necessary, by having the patient, after the tube is in the stomach, swallow large quantities of cracked ice in a short time. Continuous **hot packs**, with the **electric pad** to avoid disturbance, should be used. J. E. Loveland (Surg., Gyn. and Obst., Mar., 1925).

Serum Treatment.—Polyvalent sera to neutralize both *Bacillus coli* and streptococcus infections are available, but the results obtained with them have not been very satisfactory so far. Antistreptococcic serum has been used extensively in puerperal septicemia—without, however, any marked success.

Injections of **horse serum** were administered by the author in 34 cases

of incipient or developed peritonitis, some of the postoperative type and others arising from various causes. In adult patients 40 c.c. (1½ ounces) of sterile serum were injected intramuscularly; in children, 20 c.c. (¾ ounce). Although in a few cases the injections had no noticeable effect, in many there was strikingly rapid subsidence of the peritoneal disturbance. T. Hirano (Deut. Zeit. für Chir., Sept., 1913).

One to 3 **blood transfusions** carried out in 8 cases of septic peritonitis following appendicitis. Whereas this complication, when otherwise treated, always terminated fatally, all of the 8 patients recovered. The amounts of blood transfused were 100 to 200 c.c. Caplesco (Bull. de l'Acad. de méd., Jan. 5, 1926).

ACUTE CIRCUMSCRIBED PERITONITIS.—Acute non-suppurative circumscribed peritonitis occurs over organs the seat of inflammation, such as the appendix, the intestines, the female genital organs, the gall-bladder, and the liver, resulting in a localized inflammation of the peritoneum. Occasionally a splenitis or hepatitis may result from spreading of an inflammation of the pleura or pericardium through the diaphragm. The chief and, practically, the only *symptom* of the condition is localized pain of varying severity, usually increased by pressure. Rarely a friction rub may be heard over the spleen or liver. The occasional *effects* of localized peritonitis are more important, and consist in the formation of local adhesions. Local peritonitis is, in fact, a method by which nature may prevent a general infection of the peritoneal cavity by walling off an abscess, a perforating ulcer, or other common source of peritonitis. These adhesions, again, may themselves become the cause of disturb-

ances of a mechanical nature,—internal herniæ, obstructions in the neighborhood of the pylorus, and adhesive bands in various parts of the abdomen and pelvis, particularly in women.

The consideration of these disorders is best taken up in connection with the organs or regions where they are located.

The *treatment* of acute non-suppurative peritonitis is symptomatic, *viz.*, the relief of pain, chiefly by **external hot or cold applications**, according to the patient's personal predilections. Opiates are rarely required in these cases.

Suppurative Circumscribed Peritonitis.—Under this general title are included abscesses in relation with various organs and regions of the abdomen, such as perigastric abscess, pericolic abscess, retroperitoneal abscess, and subphrenic abscess.

A **retroperitoneal abscess** may result from a variety of causes, such as disease of the lung resulting from tuberculous, psoas, or iliac abscess; disease of the kidneys, such as calculus or tuberculosis; or traumatism resulting in a perinephric abscess; infected retroperitoneal glands; occasionally perforations of viscera, either traumatic or ulcerative. The local signs are often very obscure, or even entirely absent, and the *diagnosis*, therefore, except in the well-defined types, such as psoas abscess or abscess of the kidney, practically impossible. The general symptoms of sepsis (pain, fever, rigors, and leucocytosis) are usually present, but suggest a general infection rather than a local focus.

The *treatment*, when the diagnosis can be made, is purely surgical.

In local peritonitis following a septic puerperium, simple **drainage** through Douglas's pouch should, according to Hicks, always be adopted when the local area of infection is within reach. Any attempt at radical removal of a pyosalpinx or an infected ovary will induce a severe general sepsis which may be quickly fatal.

SUBPHRENIC ABSCESS.

Subphrenic abscess occurs secondary to infection in some other organ, not necessarily contiguous to the diaphragm. Among the common causes may be mentioned appendicitis. The abscess is usually on the right side. The complication is serious, and is not so very uncommon. Among 86 fatal cases of acute appendicitis, a subphrenic abscess was found in 7, or 8.13 per cent. (Christians and Lehr.)

In 2 of the writer's 4 cases the only apparent source of subphrenic abscess lay in furuncles which had run their course a few weeks before the initial symptoms of the abscess. In another, there had been a lung infection, presumably bronchopneumonia, while in the fourth, a definite cause for the abscess was discovered, *viz.*, a ureteral calculus with pyonephrosis. Prompt recovery followed evacuation of the abscess in each case. B. Akerblom (Acta med. scand., Jan. 24, 1924).

Abscess of the liver, or suppurating hydatid cyst, represents another occasional cause of subphrenic abscess. Abscess of the spleen is rare. Perforation of a gastric or a duodenal ulcer may give rise to a gaseous subphrenic abscess if the perforation has been sufficiently large. Occasionally, a subphrenic abscess results from disease of the pancreas, gall-bladder, or kidney; and it may even arise from tuberculous disease of the spine. Nevertheless, subphrenic abscesses due to these causes are rare. Finally, the source of infection in

cases of subphrenic abscess may be undiscoverable.

As the appendix and the liver are the most common sources of infection, it follows that simple subphrenic abscess is more common on the right than on the left side. The abscess may be intraperitoneal or extraperitoneal, but is usually the former. Elsberg collected 73 cases of subphrenic abscess due to appendicitis, and found that the abscess was intraperitoneal in 35, or 48 per cent.; in 20, or 27 per cent., it was extraperitoneal; and in 18, or 25 per cent., the relation to the peritoneum was not determined.

The boundaries of a subphrenic abscess, which are determined by the organs and structures with which it is in contact, may be still further modified by the presence of adhesions, and are, therefore, subject to great variations. The adjacent pleura usually becomes affected, with a resulting effusion, which may remain serous and sterile, or may likewise become purulent. The abscess may actually perforate the diaphragm and discharge its contents into the pleura, producing an empyema; or into the pulmonary tissue, producing multiple abscesses or gangrene. It is interesting to note that the pyopneumothorax in cases of subphrenic abscess is not necessarily due to a communication with the lung or with any hollow viscus, the gas being the result of bacterial activity. Occasionally the abscess may rupture externally or into the stomach or colon; but this is rare. Rupture into the peritoneal cavity is always to be feared, and is usually fatal.

SYMPTOMS.—As the development of subphrenic abscess is usually

gradual, the symptoms are difficult to distinguish from those of the primary disease. The general symptoms of infection—fever, diarrhea, rapid pulse, etc.—persist; and it is only after a time that the physical signs at the base of one or the other lung suggest the complication that has developed. This may occur, however, in cases of abscess due to appendicitis; and thoracic manifestations may precede the usual signs of appendicitis. When the abscess is on the right side, the symptoms are those of hepatic, or possibly pancreatic, disease. Rarely, as after perforation of a gastric ulcer, the onset is sudden, with pains and the signs of pneumothorax.

Unless the abscess is opened, the tendency is toward progressive loss of strength, and death eventually results from exhaustion, after a duration that may be as much as two or three months. Spontaneous rupture into the pleura, lung, bronchus, peritoneum or one of the abdominal viscera is rare.

DIAGNOSIS.—The *physical signs* vary according as the abscess is simple (does not contain gas) or gaseous. More commonly the physical signs produced by a subphrenic abscess are found posteriorly over the base of one or the other lung. There is dullness, which slowly spreads upward toward the scapula, with the signs of compression of the lung above the area of dullness. Along with these phenomena, the signs of pleurisy, with or without effusion, may be present. In the main, the signs of subphrenic abscess are simply those of a pleural effusion. Litten's diaphragm phenomenon may be useful in enabling one to decide, in a

doubtful case, whether the effusion is above or below the diaphragm. This, however, may be done with still greater certainty by means of the X-ray, which not only indicates the position of the effusion, but also—by means of a fluoroscopic examination—shows the limitations in the excursion of the diaphragm. In those cases in which the abscess is more anterior, the signs are more prominent in the abdomen. They consist in tenderness and a fullness below the costal margin, and possibly a palpable tumor, which is dull on percussion. This may, however, be modified by the interpolation of a coil of intestine between the abscess cavity and the abdominal wall—a point to which attention has been called by Godlee. Occasionally redness and edema of the skin (inflammatory edema) may be present; and if the abscess is very superficial, fluctuation may even be elicited. The symptoms and secondary signs of sepsis—sweating, irregular temperature, leucocytosis, and anemia—may be present. Clubbing of the fingers is said never to occur with a subphrenic abscess, but only with lesions above the diaphragm.

After any of the conditions that are known as possible causes of subphrenic abscess, particularly after disease of the appendix or gall-bladder, or any lesion in the neighborhood of the diaphragm, a systematic examination of the base of the lungs, not omitting an X-ray study, should be made whenever the patient fails to recover within the expected time and the signs of suppuration persist. If an abscess is suspected, the diagnosis may be confirmed by means of the exploratory needle. The needle should, however, be large enough to

permit the passage of thick pus. The tenth, ninth, eighth, seventh, and sixth interspaces, in the scapular line, are explored in turn; and if no pus is found, the same spaces in the mid-axillary line should also be explored before the attempt is abandoned. The patient should be fully anesthetized during the procedure. On the other hand, exploration through the abdominal wall is not advised. The differentiation of subphrenic abscess from *empyema* offers the greatest difficulty, which, however, can usually be overcome with the aid of the X-rays, as has been stated. It is always to be remembered that fluid may be present both above and below the diaphragm. If this condition is suspected, it may be confirmed by the difference in the character of the fluid obtained by exploratory puncture through different interspaces. "Fürbringer's sign" may be of value in determining the position of a collection of fluid. If the aspirating needle is above the diaphragm, no movement of the needle will occur. On the other hand, if the needle passes through the diaphragm, the needle will move upward on inspiration and downward on expiration. Another sign that is characteristic is that suggested by Pfuhl: when the needle enters a subphrenic abscess the pressure and outflow are greater during inspiration and less during expiration, the reverse being the case in *empyema*.

When the subphrenic abscess contains gas, the term "subphrenic pyopneumothorax" is employed. The commonest cause of such an abscess is perforation of a gastric ulcer, particularly if the perforation occurs on the posterior surface of the organ, a

similar accident on the anterior surface being more likely to result in general peritonitis. The perforation of a duodenal ulcer is also an occasional cause.

Certain differences in the *symptomatology* are observed when the abscess contains gas. The onset is usually sudden and the pain severe, the symptoms being, in fact, due to the perforation of a hollow organ, which produces the abscess. The pain is usually accompanied by vomiting. The vomitus contains blood and bile. The abdomen rapidly becomes extremely tender and, as a rule, distended; although it may be rigidly contracted and immovable on respiration.

The *physical signs* are those of pneumothorax, with certain differences, due to the anatomy of the condition. On the right side, the diaphragm may be greatly displaced upward—sometimes as high as the second rib; while on the left side the same degree of displacement is prevented by the presence of the heart. The same variation of dullness and tympany with a change in the patient's position is observed as in pyopneumothorax. Metallic tinkling, amphoric breathing and the succussion splash may be heard, as in the former condition. In left-sided subphrenic abscess, the heart will be displaced upward; but laterally the displacement will be very much less than in pneumothorax of the same relative severity. In right-sided cases the liver is displaced downward, and may be palpable at the level of the umbilicus, the hepatic dullness being, of course, absent from its normal position.

In the diagnosis between *pyopneu-*

mothorax and a gaseous subphrenic abscess, certain points may be of value. The apex of the heart, if displaced, is displaced upward, but very little to the opposite side. The physical signs of pneumothorax are confined to the lower part of the lung, leaving the upper portion comparatively normal. The characteristic signs of pneumothorax may be obtained farther down than the normal limits of the thoracic cavity. Cough and expectoration are not prominent symptoms. Finally, the X-ray will assist in clearing up the diagnosis, by locating the position of the diaphragm. The possible association of subphrenic pyopneumothorax with a *pleural effusion* must also be borne in mind. This condition may be detected by the same methods as have been discussed in connection with non-gaseous abscesses.

PROGNOSIS.—The prognosis of subphrenic abscess is always grave, and is rendered still more so when the abscess contains gas.

TREATMENT.—The treatment is entirely surgical.

SIMPLE CHRONIC PERITONITIS.

While the common classification into circumscribed and diffuse is usually maintained in textbooks, a chronic peritonitis is, as a matter of fact, rarely general or equally distributed over the entire peritoneum. The distinction between simple diffuse peritonitis and tuberculous peritonitis, or that which accompanies malignant disease is always difficult. Indeed, it may almost be said that a chronic peritonitis is called simple when both tuberculosis and neoplasm can be excluded from the etiology.

The terms proliferative, indurative, exudative peritonitis, which are frequently employed, explain themselves. Ascites is usually a prominent feature of the condition. When, as is frequently the case, the peritonitis is associated with chronic inflammation of the pleura and pericardium, with the production of exudates in these cavities, the term "polyserositis," "polyorrhomenitis," or "Concato's disease" is frequently employed. The extent to which the different serous membranes are involved and the order of their involvement are both subject to considerable variations. The condition is characterized, in a general way, by thickening of the membranes, the extent of which depends on the duration of the process. It may even go to calcification. Dense adhesions of the two layers of the pericardium (adherent pericardium), or between the pericardium and the covering of the liver are associated with the presence of effusion. The various types of polyorrhomenitis have been classified according to the point of origin of the inflammation—whether above or below the diaphragm. Thus, pericarditis may be the primary lesion, and may be followed later by perihepatitis and peritonitis; or the reverse may be the case. The process is, as a rule, most marked over the liver and spleen. In the former it gives rise to the condition which Curschmann has called "*Zuckergussleber*" (icing-liver), and which we usually designate simply chronic perihepatitis. On the other hand, Pick describes a condition that he calls "pericardial pseudocirrhosis," which, he believes, originates in adherent pericardium, gives rise to secondary circulatory disturbances in

the liver and produces thickening of the capsule, ascites, and the signs of cirrhosis generally. Simple chronic peritonitis is also found in association with arteriosclerosis and chronic Bright's disease, which are regarded by a number of authorities as the principal causes of the condition.

SYMPTOMATOLOGY.—While the disease is most common in middle age, it will be remembered that a number of cases of polyserositis have been described as occurring in children. The principal clinical manifestation is chronic ascites, tending to recur after removal by tapping. The number of tapplings required in a single case may be enormous, and eventually a cure—or, at least, an arrest of the ascites—may be obtained. Occasionally the ascites is encysted, causing irregular enlargements of the abdomen and complicating the diagnosis. The symptoms and signs of chronic disease of the heart and kidneys are frequently present. The urine is scanty, and middle-aged patients usually show the signs of chronic interstitial nephritis. Jaundice is not usually present. The course is insidious, and the disease usually manifests itself first by discomfort and rumbling in the abdomen, due to the accumulation of the fluid. Constipation and some degree of dyspepsia are usually present. Edema of the feet, developing after the ascites has been present for some time, is a rather constant finding.

PROGNOSIS.—This is generally unfavorable; but some cases, as has been stated, achieve a relative recovery after numerous tapplings. The duration varies, according to Nicholls, between two and sixteen years. Death usually occurs from some

intercurrent infection, such as pneumonia, or is due to cardiac failure.

ETIOLOGY.—This is not very clear. It has been explained either by infection with organisms of low virulence which are able to exert their influence on account of the diminished bactericidal power of the blood that is said to be a resultant of chronic renal disease; or, by the action of the uremic poison present in the blood of patients with arteriosclerosis and chronic nephritis, directly producing the inflammatory changes in the serous membranes. Alcohol, lead, and other poisons are believed to play a secondary part in the etiology, by reducing the resistance of the peritoneum. Finally, a simple chronic peritonitis may develop in connection with some inflammatory abdominal lesion, which in ordinary circumstances would be followed by local peritonitis and abscess. Such lesions are chronic cholecystitis or duodenal ulcer and syphilitic disease of the liver. Some authorities still believe that chronic peritonitis is always tuberculous. Other bacteria that have been suggested as the cause are *Bacillus coli* and *Bacillus typhosus*. It is certain, at least, that tubercle bacilli are not infrequently found in cases with ascites that do not present the usual signs of tuberculous peritonitis.

TREATMENT.—The treatment is necessarily palliative and symptomatic, with such measures as can be instituted to combat the cause, if it can be determined,—whether heart disease, nephritis, syphilis, or any other morbid condition. The Talma-Morison operation, which has been suggested, fails to give relief. The fluid must, of course, be removed

whenever it accumulates in sufficient quantity to produce discomfort; and the **tappings** must often be repeated at short intervals. The injection of **adrenalin chloride**, 1 dram (4 Gm.) in an ounce (30 c.c.) of water, which has been recommended in cases of ordinary cirrhosis, may also be tried. Laparotomy is not indicated.

TUBERCULOUS PERITONITIS.

This term, as generally used, includes, besides the inflammatory change in the membrane itself: tuberculous ulceration of the intestine; tuberculous infection of the glands in the peritoneal cavity; and, in female subjects, tuberculosis of the female genitalia, particularly the Fallopian tubes. An acute form of tuberculous peritonitis has been described, beginning usually, in the appendiceal region, and clinically not to be distinguished from appendicitis. The infection probably reaches the peritoneum through the lymphatics, from primary foci that may be located in various parts of the body,—the lungs, intestines, lymphatic glands, pleuræ, prostate, testicles, etc. In the majority of cases, according to Nothnagel, the lungs are primarily affected, and tuberculous peritonitis develops without the presence of intestinal ulceration. The latter, indeed, quite frequently occurs secondarily to pulmonary tuberculosis without implication of the peritoneum. In women, tuberculosis of the Fallopian tubes is a very common source of tuberculous peritonitis. The bacillus of bovine tuberculosis is believed to be a prolific if not the most common cause, though a certain proportion of the cases, at least, are probably due to

the human tubercle bacillus swallowed with the sputum.

From the clinical as well as the pathological standpoint, a certain classification is desirable, although the various forms necessarily overlap. Such classifications have been suggested by a number of writers, and may be summarized as follows:—

1. An *ascitic*, exudative, serous, or miliary form, characterized by an abundant effusion and miliary tubercles disseminated over the peritoneum.

2. A *nodular*, ulcerative, or perforative form, called "chronic tuberculosis" by Osler, in which there is a tendency to the formation of larger growths, which ultimately ulcerate or become caseous; the fluid in these cases being partly purulent, the term "suppurative" is sometimes employed.

3. A *fibroplastic*, adhesive, or obliterative form, or "chronic fibroid tuberculosis," with little or no exudation and massive adhesions.

The first, or ascitic form, is more acute in its course, and may be associated with miliary tuberculosis. There are few if any adhesions, and the exudate is free in the peritoneal cavity (not encysted). The miliary tubercles are found over the intestines, mesentery, omentum, and diaphragm, as well as on the peritoneum itself.

In the second or nodular form, the lesions are much larger and somewhat pigmented, and there is thickening of the peritoneum and omentum, causing a resemblance to malignant disease. Adhesions form between the intestines and the spinal column. These adhesions give rise to the formation of pockets, which may contain serous or purulent exudate. The

mesenteric glands are enlarged and caseous, and sometimes converted into an abscess.

The third or fibroplastic type is characterized by universal adhesions, causing a matting together of the abdominal viscera and their attachment to the abdominal wall. Clinically this gives rise to tumor-like masses, which may be felt through the abdominal wall. This obliterative form may be the end-result of the ascitic type of tuberculous peritonitis, or it may develop independently.

Finally, it is to be observed that tuberculous peritonitis may be associated with cirrhosis of the liver, the latter being apparently the earlier process. Involvement of the peritoneum in simple chronic peritonitis or polyserositis has been discussed.

SYMPTOMATOLOGY.—This is vague. There is moderate fever, with general loss of strength and flesh, and indefinite pain and discomfort in various parts of the abdomen. In women there is often pelvic pain. In the ascitic form there is gradual enlargement of the abdomen with, finally, the appearance of the definite signs of ascites. A certain relation between the clinical symptoms and the pathological types described has been established. In the ascitic or miliary form abdominal distress and the signs of effusion are prominent. In the fibroplastic form the symptoms characteristic of the presence of adhesions, kinks, bands, painful tumors, etc., are in evidence, and emaciation and cachexia are apt to be more pronounced. As the disease is so frequently secondary to pulmonary tuberculosis, the characteristic signs should always be looked for in the lungs. Moderate diarrhea is common, and this symp-

tom is exaggerated when there is extensive intestinal ulceration, which, as has been stated, may be regarded as belonging to the picture of tuberculous peritonitis. Perforation of a tuberculous ulcer, although rare, sometimes occurs. In a case seen by the author, which occurred only a few days after the patient's admission to the hospital, the diagnosis between tuberculous peritonitis and typhoid fever had not been definitely determined before the autopsy, which revealed extensive tuberculous ulceration. In this case the symptoms and course during the two days the patient was under observation closely simulated those of a grave case of typhoid fever previous to perforation. The disease may be latent for some time, and may be revealed by the sudden onset of an acute peritonitis, due to some accident, such as the rupture of a caseous gland or of an ulcer; intestinal obstruction from a strangulating band; or, as has been suggested, thrombosis in the mesenteric vessels, causing sudden paralysis of a segment of intestine. The ascitic fluid contains the bacilli in very small numbers only, so that they are rarely discovered by ordinary microscopic examination. By Jousett's method of inoculation, the bacilli may, however, usually be detected. In this respect, the ascitic fluid is analogous to the effusion in tuberculous pleurisy.

DIAGNOSIS.—The diagnosis, as a rule, presents no especial difficulty, as in a large number of cases evidences of tuberculosis are found elsewhere in the body—the lungs, the Fallopian tubes, the testicles, etc. In children tuberculosis is the most common cause of ascites. From *typhoid fever*, which it very often resembles, it

can usually be distinguished by means of the biological tests. In cases of doubt between tuberculous peritonitis and *cirrhosis of the liver*, the history is usually of assistance in the case of adults, although in the rare instances of cirrhosis of the liver in children the difficulties are considerably greater, such cases being usually taken for tuberculous peritonitis. The association of the two conditions has been pointed out. A point of some importance is the cytology of the fluid: In tuberculous peritonitis the lymphocytes usually predominate, while in cirrhosis of the liver there are few if any lymphocytes, and endothelial cells are chiefly found. The fibroplastic form may be difficult to distinguish from *malignant infection of the peritonium*. Here, again, examination of the fluid may be useful.

Physical sign which has proved very helpful in differentiating abdominal enlargement associated with rachitis from that of tuberculous peritonitis. Whereas in rachitis the greatest prominence of the abdomen is manifested at the epigastrium, in tuberculous peritonitis the abdominal circumference is largest at or below the umbilicus (hypogastrium). This differential physical sign can best be elicited by careful measurements of the abdominal circumference by means of a tape-measure, but can readily be determined also by mere inspection. It can be explained by the fact that in tuberculous peritonitis the inflammatory exudate accumulates at the bottom of the abdominal cavity and thus distends the surrounding abdominal wall. To make correct use of the sign, however, one must be sure to exclude large dermoid cysts of the ovary and an overdistended bladder, both of which are apt to lead to diagnostic errors. Herman B. Sheffield (*Med. Rec.*, Aug. 30, 1913).

Injury of the peritoneum may act as primary cause of tuberculous peritonitis owing to the reduced resistance of the peritoneal tissues to infection which results from the injury. The symptoms of the disease thus induced may appear 6 months or longer after the traumatism. Gerhartz (Med. Klin., Feb. 17, 1924).

PROGNOSIS.—It is generally admitted that spontaneous cure is possible in peritoneal tuberculosis; and this in part explains the good results that have been attributed to treatment by means of laparotomy. Complete cure is, of course, rare; but temporary improvement of variable duration is not infrequently observed. The proportion of permanent cures has been estimated as high as 50 per cent. Unfavorable factors influencing the outcome are: persistent fever, wasting and diarrhea, the presence of complications such as pulmonary tuberculosis, intestinal ulceration, meningitis, and the development of localized abscesses. After apparent cure there is a marked tendency to recurrence, due to the persistence of some undiscovered source of reinfection, indicating the necessity of removing any local focus that may be found in the Fallopian tubes, intestines, glands, or elsewhere. A remote effect of tuberculous peritonitis is the formation of peritoneal adhesions, and the danger of mechanical strangulation of the intestine to which they may give rise. This complication, however, is not very common.

The prognosis of tuberculous peritonitis is good. According to Ochsner, 50 per cent. are cured by medical treatment alone, while 50 per cent. of the remainder are cured by surgical intervention. Cases should be well for at least 3 years before pronounced cured. The chronic ulcerative

cascating variety presents the least chance of recovery with either method of treatment. Cashman (Am. Jour. Med. Sc., cliv, 269, 1917).

TREATMENT.—The advisability of laparotomy in the treatment of tuberculous peritonitis is a question still in dispute.

[Numerous statistics have been collected, both by surgeons and by physicians. F. C. Shattuck reported 37.5 per cent. of deaths among 52 cases treated surgically, as against 68 per cent. in 46 cases in which no laparotomy was done. The latter, however, were complicated by tuberculosis elsewhere in the body. Elastratov found 68.4 per cent. of deaths among 136 cases treated medically, and 21.7 per cent. among 240 cases treated surgically. Roersch analyzed a series of 358 operative cases, of which 71 per cent. recovered. Statistics showing a greater percentage of recoveries among cases treated medically are, however, not wanting. Sutherland, Borchgrevink, Pfenger, Saltykow, and others have collected series of cases in which the percentages of recoveries were greater among the cases treated medically than among those subjected to laparotomy. Thus, as high as 82 per cent. of recoveries under medical treatment were reported. R. M. GOEPP.]

The advocates of medical treatment do not deny that a large number of cases have recovered after surgical treatment, but they insist that the good effects are to be attributed as much to the natural tendency of the disease toward spontaneous recovery as to the operation itself. It is also stated that **paracentesis**, with the injection of **iodoform emulsion in glycerin**, gives as good results as laparotomy.

Schramm found 80 per cent. of cures among the operated children and 64 per cent. among the non-operated; Pic observed recovery in 74 per cent. of the operated patients and in 5 per cent. only of the non-operated; Wutherland observed re-

covery in 50 per cent. of the operated patients and in 81 per cent. of the non-operated. By adding up all the operated patients we get 88 cures, or 70.4 per cent., in 125 cases, as contrasted with 51 cures, or 33 per cent., in 156 patients not operated on. The **operation** on ascitic cases should be tried after **hygienic and medical treatment** has been given a fair trial for a month, or so without any definite benefit. Simple paracentesis is not often necessary and is seldom practised. After **removal** of some of the **fluid**, **injections** of various kinds through a cannula have been employed; thus **sterilized air**, **oxygen** (Schulze), **isotonic salt solution**, **epinephrin** (adrenalin) (Wynter) have been reported to give good results. The injection of **camphorated naphthol** is **dangerous** (Guinard). Rolleston (Brit. Med. Jour., Sept. 2, 1911).

Injection of nitrogen was tried by the author, in a young man who developed tuberculous peritonitis with recurring ascites. There was no benefit from laparotomy twice repeated, Röntgen exposures, or incisions. After tapping and withdrawing 2.5 liters (quarts) of ascitic fluid, the author injected 500 c.c. (1 pint) of **nitrogen** into the peritoneal cavity by the ordinary artificial pneumothorax technique. Nine days later 600 c.c. (1½ pints) were injected without withdrawing the effusion present. A third and a fourth injection of 800 c.c. (1¾ pints) and 600 c.c. (1½ pints) of nitrogen followed, all in the course of two months. The patient improved rapidly and the abdomen appeared free from ascites. Eight months after the beginning of the injections, the patient seemed entirely cured. Bruckner (Berl. klin. Woch., Jan. 19, 1914).

The following **operative treatment** in tuberculous peritonitis in 31 cases (27 adults) yielded improvement, usually very marked, in all but 4 cases. An incision 3 to 4 inches long was made through the sheath of the right rectus and the patient eviscerated in so far as possible, the intestines be-

ing caught in a nest of hot, moist towels and thoroughly washed with a solution of 50 per cent. commercial **hydrogen dioxide**. The abdominal cavity was then thoroughly flushed with the same solution, after which it was washed with equal thoroughness with normal **saline solution**, as were also the intestines. The latter were then replaced and the wound closed with 3 layers of sutures. Primary union followed in every case. The patient must be got out of bed and about as soon as possible. Judd (N. Y. Med. Jour., June 6, 1914).

The cases of tuberculous peritonitis in which surgical treatment promises to be of great aid, divide themselves into two groups. 1, and most favorable are those cases in which a definite anatomic portion or viscus of the peritoneal cavity is involved, such as the Fallopian tubes, the ileocecal coil and the appendix, which can be removed. 2, and less favorable, are those in which the peritoneal cavity contains a considerable quantity of fluid occupying either the entire peritoneal cavity or a large part of it, or in which the fluid is contained in loculi composed of peritoneal adhesions, dividing the peritoneal cavity into compartments containing fluid. The writer emphasizes the importance of removal of diseased Fallopian tubes in women with tubercular peritonitis. W. T. Mayo (Jour. Amer. Med. Assoc., July 6, 1918).

Tubercular peritonitis most frequently attacks young women. As operation cures most cases, large tubercles being absorbed, even those of the tubes and uterus, they should not be sterilized. Carstens (Amer. Med. Assoc. Trans.; N. Y. Med. Jour., June 21, 1919).

In deciding this question it should always be remembered that the cases subjected to operation are selected cases, and that the statistics in a series of this kind are, therefore, likely to be more favorable. Extensive tuberculosis elsewhere is re-

garded as a contraindication to laparotomy, and only those cases with effusion are, as a rule, selected. A conservative statement is that laparotomy probably exerts a hastening influence on cases that already tend to spontaneous cure. Operative treatment, therefore, should be resorted to in favorable cases, after a reasonable length of time (say, four to six weeks) has elapsed under careful hygienic and medical treatment, without any definite evidence of improvement, and whenever there is a definite surgical indication, such as the presence of localized abscess, or of a tuberculous focus that can be removed surgically.

The **fresh-air treatment** is as applicable to intestinal as to pulmonary tuberculosis, and is particularly important in the case of children. Diarrhea is a symptom that requires attention. If the stools are offensive **guaiacol** should be administered, and, if necessary, one of the **bismuth salts**. **Codliver oil** and the **syrup of the iodide of iron** are still popular, especially in pediatric practice. **Tincture of iodine** has been applied externally.

In a cachectic case in a young woman, in which 3 laparotomies had failed to check the disease, cure took place under 4 months of **heliotherapy** in Paris in a favorable season. General sunbaths were taken for 3 hours morning and afternoon. Armand-Delille (Bull. Soc. méd. des hôp. de Paris, Oct. 21, 1921).

Mercurial ointment has also been used locally. It is doubtful, however, whether these remedies add anything to the good effects of general hygienic treatment.

Hofmann has reported uninterrupted recoveries following application of 10 per cent. **tincture of iodine** to the peritoneum, omentum, and intestines at operation. Pon-

toiseau favors subcutaneous injection on alternate days of 2 to 4 c.c. ($\frac{1}{2}$ to 1 dram) of a solution of 10 per cent. each of **iodine** and **potassium iodide** in normal salt solution. If the injections prove painful an **ointment of iodine** may be substituted. Périer lands a group of measures comprising a **non-fluid** and **salt-free diet**, **fluid restriction**, a **wet compress** continuously on the **abdomen** (covered with oiled silk), complete **rest in bed** with the windows open, and lime in the form of: **Calcium carbonate**, 0.65 Gm. (10 grains), and tribasic **calcium phosphate**, 0.2 Gm. (3 grains), with **sodium chloride**, 0.15 Gm. ($2\frac{1}{2}$ grains); one such capsule to be taken 3 times daily after meals. This treatment is held particularly suitable for cases with anorexia, vomiting, and diarrhea.

In 2 apparently hopeless cases of tuberculous peritonitis in children, Lawrie found the following mixture very beneficial:

R. Calcii carbonatis

(precip.) 8 Gm. (2 dr.).

Olei creosoti 2 c.c. (32 min.).

Mucilaginis traga-

canthæ q. s.

Potassii iodidi ... 1 Gm. (15 gr.).

Glusidi 0.5 Gm. ($7\frac{1}{2}$ gr.).

Olei menthæ pip. 0.33 c.c. (5 min.).

Aqua ad 240 c.c. (8 oz.).

M. Sig.: Two drams every four hours for a child of 5 years.

(**Tincture of opium** or **paregoric** may be added for pain and diarrhea, if present.)

Good results have been reported from **tuberculin**, administered by mouth or in the usual manner, by hypodermic injection.

Much more numerous, however, have been the favorable reports on the introduction of **filtered air** or **oxygen** into the unopened peritoneal cavity.

Six cases treated by tapping under local anesthesia with trocar and suction apparatus, followed by **injection of filtered air** to an amount of about $\frac{1}{2}$ of the fluid withdrawn. In 3 cases effusion rapidly disappeared after 1 or 2 injections and there was complete cure without adhesions; in 2, effusion

disappeared, without cure, and 1, with active bilateral lung tuberculosis, was not benefited. The procedure is especially advised for the acute stage. When effusion and fever are gone, **sun-baths** should be given. Weil and Loiseleur (*Bull. Soc. méd. des hôp. de Paris*, Dec. 22, 1921).

Pneumoperitoneum recommended in preference to laparotomy, the artificial introduction of air being as effective as when it is admitted through an abdominal incision. In a personal case, 6 liters of yellowish fluid were first withdrawn from the abdomen, and 5 days later another 4 liters, followed by the introduction of 1500 c.c. sterile air by means of an artificial pneumothorax apparatus. At the end of a week, another liter was withdrawn, and 500 c.c. of air introduced. After the first inflation, the patient experienced considerable distress; but the temperature fell from 99.5 to 101.8° F. (37.5° to 38.7° C.) to normal in 2 weeks. After the second treatment, the gastric symptoms rapidly disappeared, and the patient, a physician, has steadily improved ever since, having taken up his practice again in 1921. The writer refers to similar results obtained by Stein and others. He employed the same treatment in a boy of 18 years, supplementing it with **natural and artificial heliotherapy**. O. M. Gilbert (*Amer. Rev. of Tub.*, Jan., 1924).

Case in which **intraperitoneal oxygen inflation** was used successfully, even though marked ascites was present. The method is easy and free of danger, and offers as good a prospect of ultimate cure as any of the other methods of treatment, including **celiotomy, X-rays and heliotherapy**. Mattick (*Amer. Rev. of Tub.*, Jan., 1924).

A case proven to be extensively tuberculous by abdominal section was given 350 c.c. of **oxygen** by injection into the peritoneal cavity at a time when she seemed so near her end that her family had been summoned. Vomiting ceased, the bowels moved, appetite returned, the temperature dropped, the pulse was reduced in fre-

quency, and the patient regained her health. The injections were repeated at intervals of 2 or 3 weeks, 250 to 400 c.c. of oxygen being given each time. The case was of the non-exudative type. An explanation for the action of the oxygen has been suggested by Wells and his collaborators. While, during the growth of the tubercle bacilli, oxygen is absorbed and carbon dioxide given off, an oxygen pressure much over normal inhibits the growth of the germs. Again, in order that the growth of the tubercle bacilli may take place, the carbon dioxide must reach a certain concentration. The introduction of oxygen into the abdominal cavity, owing to the pressure of the oxygen and the reduction in the concentration of carbon dioxide surrounding the tubercle bacilli growing in the peritoneal cavity, inhibits the growth of the bacilli. Hayes (*Jour.-Lancet*, Nov., 1924).

The **X-rays** and other rays are also used, apparently with benefit.

Report on 100 cases treated with the **quartz lamp** in a Polish hospital. The patients were placed directly under the lamp at a distance of 1 meter and the rays applied for 1 to 3 minutes. Exposures were given on alternate days, each time shortening the distance by a few centimeters and lengthening the time of application. Results were very rapid. The treatment renders laparotomy unnecessary. S. Newman (*Va. Med. Mthly.*, Nov., 1921).

X-rays recommended. The writer gives 8 exposures, followed by a rest of 20 days. Two or 3 such series are curative. The monthly dosage was always $\frac{1}{3}$ of the erythema dose. The abdomen and back were divided into 8 zones, 4 anterior and 4 posterior. Sessa (*Radiol. med.*, Feb., 1922).

In some cases, even of diffuse tuberculous peritonitis, the **ultra-violet rays**, used alone, caused improvement. In resistant cases, the **X-rays** and **infra-red rays** were employed in addition. The ultra-violet rays act on the general condition and accelerate absorption; the X-rays act on the deep in-

filtrations and the infra-red rays on the superficial infiltrations and the pain. The best results were obtained by combining the 3 agents. J. Saidman (Jour. des prat., Oct. 24, 1925).

TUMORS.

Non-malignant tumors of the peritoneum, which include tumors of the omentum and mesentery and retroperitoneal tumors, may be divided into solid and cystic.

Fibromata.—Pure fibromas are rare, and are usually found in connection with the mesentery, omentum, or retroperitoneal space. They are commonly single and may attain considerable size. A type of so-called fibrosarcoma (although non-malignant) of the anterior wall is described, occurring particularly in multiparous women during pregnancy. These tumors arise from the aponeurosis or from the tendons or the sheaths of the muscles; possibly, also, from the round ligament of the uterus. They are benign. When discovered during pregnancy, removal is not indicated, as the operation would unnecessarily weaken the abdominal wall.

Fibromyomata occasionally arise from the mesentery. This fact is interesting chiefly as showing that these tumors do not always arise from the uterus or the broad ligament. Clinically, they usually resemble the ordinary uterine fibroid, and the diagnosis is correspondingly difficult.

Lipomata may develop from collections of fatty tissue in various regions of the abdomen, such as the hernial orifices, the fat surrounding the kidneys and the fatty tissue in the iliac fossa and the retroperitoneal space. These tumors occasionally attain considerable size. They may be detected by palpation, although,

owing to their soft consistency and the yielding nature of the surrounding tissues, this may present a good deal of difficulty. As they are often semifluctuating, they may be mistaken for encysted ascites, or they may be confused with ovarian or hydatid cysts.

The operative technique presents a difficult problem, particularly when the lipoma is retroperitoneal, on account of the difficulty of avoiding the vessels running to the intestines, so as not to cut off their blood-supply.

Cysts.—The most important are the parasitic cysts which give rise to *hydatid disease* of the peritoneum. These cysts, as is well known, represent the bladder stage of *Taenia echinococcus*, which exists as a tapeworm in the dog and related animals. Dissemination of the cysts on the peritoneum is believed to result from the rupture of a single primary cyst, usually in the liver. The number of these peritoneal cysts may be enormous, and they may be scattered over the entire omentum, mesentery, and visceral peritoneum, the omentum and pelvis being the most frequent sites. They vary in size from a pinhead upward, and are either sessile or pedunculated. A variable degree of chronic peritonitis may result from the mechanical irritation caused by them, in places leading to considerable thickening over the cysts. Occasionally these cysts break down and produce localized abscesses. The disease progresses very slowly, with gradual enlargement of the abdomen. The cysts are freely movable, and are apparently not connected with any of the viscera, as they change their position with movements of the patient's body.

The hydatid thrill is rarely obtained. If the enlargement becomes very great respiration may be embarrassed, and the symptoms of indigestion, constipation, etc., may develop. Various pressure symptoms may also be manifest, depending on the location of the cysts. Pressure on the inferior vena cava produces distention of the superficial veins; pressure in the pelvis is responsible for rectal and urinary symptoms, vesical pains, frequent micturition, constipation, and a feeling of weight in the perineum.

In the *diagnosis* the history of a hydatid cyst of the liver that has been tapped is strongly in favor of hydatid disease.

In women hydatid disease may be mistaken for *uterine or ovarian tumor*. *Malignancy* may usually be excluded by the slow course of the affection and the fact that the tumors are cystic. Puncture of the cysts, which was formerly resorted to, is now condemned on account of the danger of hydatid fluid escaping into the peritoneal cavity. When, however, this is done for exploratory purposes, the discovery of the characteristic hooklets makes the diagnosis certain.

The *treatment* consists in radical **removal**, whether the cyst be single, or multiple cysts be present. In the latter case operation is equally indicated, but the results are less satisfactory. **Tapping** through the abdominal wall should not be done, but when there is a single cyst in the pelvis it may be evacuated through the perineum or vagina.

Cysticercus cellulosæ is, in very rare instances, encountered in the abdomen, but gives rise to no clinical symptoms.

Mesenteric Cysts.—These include, besides hydatid cysts, *sanguineous* and *dermoid* cysts. They are usually unilocular, and the character of their contents is quite variable. The fluid may be clear, containing albumin and cholesterolin; turbid, due to the presence of blood-corpuscles; viscid, from an admixture of mucin, or chylous, when it contains chyle. The symptoms produced by the presence of these cysts are not characteristic, being those of a gastroenteritis. Occasionally there may be acute attacks of abdominal pain, which may lead to an examination of the abdomen and the discovery of the tumor. This is round, well defined, tense, movable, and usually found on the right side of the abdomen, a little below the umbilicus. The differential diagnosis must be made from a *distended gall-bladder, floating kidney, ovarian cyst with a long pedicle, pancreatic cyst*, and even an *appendicular abscess*. Diagnostic exploration is not permissible, nor should the cyst be tapped through the abdominal wall for purposes of treatment. The latter consists in **enucleation of the cyst** when possible, or in **drainage**.

Omental Cysts.—These have been described by various writers. Their presence has never been diagnosed, however, before opening of the abdomen. Large omental cysts may simulate a *loculated tuberculous peritonitis* or an *ovarian cyst*. Other conditions that must be considered in the diagnosis are: *lipomata, mesenteric and pancreatic cysts, aortic aneurism, and large cysts of the spleen*.

Dermoid Cysts.—Dermoid cysts have occasionally been found in the peritoneum, without any direct connection with the ovaries. Such tu-

mors, or teratomata, have been found between the layers of the mesentery, omentum, and transverse mesocolon, and in the retroperitoneal space. A dermoid cyst may, however, become detached from its ovary and adhere to the peritoneum. These cysts are found only in the female sex.

Malignant Tumors.—Malignant tumors may be either primary or secondary, and are far more common in the peritoneum than are the benign tumors previously discussed.

Primary malignant tumors of the peritoneum are *sarcomata* or *endotheliomata*, which appear in a variety of forms—spindle-cell or round-cell, alveolar, myxosarcoma and lymphosarcoma, and endothelioma. Some of the endotheliomas resemble alveolar carcinoma. Pigmentation is due to the presence of blood. These tumors take their origin from the endothelial layer of serous membranes, from the subserous connective tissue, or from the remains of embryonal structures—the Wolffian bodies, Müllerian ducts, and accessory adrenal bodies.

Retroperitoneal tumors may be difficult to distinguish from similar tumors arising from the organs situated behind the peritoneum—that is, the kidneys and suprarenals. A retroperitoneal sarcoma most frequently arises in the lumbar region, and oftener on the right than on the left side. There is usually some local inflammatory change with adhesions.

The *diagnosis* of these tumors is exceedingly difficult, and it is particularly hard to determine whether the suspected tumor is malignant or benign. Malignant growths, as a rule, progress more rapidly and cause more constitutional disturbance. They are also more likely to produce pain and

pressure symptoms, such as dilatation of the abdominal veins, than is the case with benign tumors. The *prognosis* is extremely grave, particularly when operative interference is impracticable. Some recoveries are, however, reported, when the sarcoma is removed early.

Secondary Malignant Disease of the Peritoneum.—This is sometimes spoken of as malignant peritonitis. The primary growth is usually situated in one of the abdominal organs, although metastasis may occur through the lymphatics from the chest or mammary gland. Occasionally the primary growth is in the testicles. In general sarcomatosis of the peritoneum metastasis probably takes place through the blood-stream.

The disease is more frequent in women than in men, probably on account of the greater frequency of malignant disease in the sexual organs and in the mammary gland of that sex. Sometimes the carcinomatous and sarcomatous growths are very small, resembling the miliary tubercles of tuberculous peritonitis, and the term "miliary carcinomatosis" is occasionally employed. From these very minute nodules the size varies to masses of considerable magnitude. In women the ovaries often become involved secondarily. The regions most frequently affected are the omentum, the mesentery, and Douglas's pouch. An interesting point is the occasional spreading of the process upward through the thoracic duct and enlargement of the glands above the left clavicle, which is accordingly an occasional diagnostic sign of some value. The absence of this sign, however, has no negative value whatever. Ascites is often

present and, owing to the formation of adhesions, may take the form of loculated collections of fluid.

The *symptoms* are those of cancerous cachexia—gradual loss of strength and flesh, anorexia and general discomfort in the abdomen. These symptoms are due in part to the primary growth in some of the abdominal viscera, and in part to the secondary cancerous peritonitis. Pain is an uncertain symptom and may or may not be present, depending somewhat on the degree of local peritonitis. Ascites is commonly present and may obscure the presence of any growth. The ascitic fluid may be clear, turbid, blood-stained, or chylous. The degree of distention varies. Dilatation of the abdominal veins may be great when there is pressure on the inferior vena cava. The veins do not converge toward the umbilicus, as in the case of portal obstruction. The skin of the abdomen becomes flaccid, and the general signs and appearances of cancerous cachexia develop. Pigmentation may be present, not only on the abdomen, but also on the face. Edema of the feet is a late symptom, due either to pressure on the inferior vena cava or cardiac weakness. Tumors may or may not be palpable through the abdominal wall, according to the quantity of ascitic fluid present. When the latter has been removed by tapping, the growths may become accessible to palpation. The disease rarely lasts more than six months.

The *diagnosis* can be made definitely only when tumors are clearly present in a patient who is known to have malignant disease of some of the abdominal viscera. In the absence of such a history, the condi-

tions to be considered are tuberculous peritonitis, and possibly multiple hydatid cysts of the peritoneum. *Tuberculous peritonitis* may be recognized by injecting some of the fluid into guinea-pigs, or perhaps by means of the tuberculin test. Blood-stained fluid is always in favor of malignant disease. The possibility of fecal accumulation should not be forgotten, and the intestinal tract should be thoroughly emptied by means of purgatives and enemas before a definite diagnosis is made. *Hydatid disease* has been discussed. The presence of enlarged glands in the groins and above the left clavicle is of some importance, particularly in those cases in which no tumors can be felt.

Occasionally microscopic examination of the fluid withdrawn may reveal the presence of small fragments of growth. Large numbers of multinuclear endothelial cells, and of cells with typical or atypical nuclear figures, are in favor of malignancy.

Treatment.—This limits itself to the **relief of pain and gastrointestinal distress**. The fluid should always be removed and **adrenalin** then injected into the peritoneal cavity.

General carcinomatosis of the peritoneum as shown by 4 personal cases sometimes yields to **deep X-ray**. But the possibility of metastasis imposes a guarded prognosis. Pfahler (Amer. Jour. Röntg., v, 319, 1918).

Case of pseudomyxoma of the peritoneum. There was early recurrence after operation, yet the woman was restored to clinically normal by a second operation. The prognosis is less grave than has been thought; life can be prolonged many years by prompt and repeated operations. Klotz (Ned. Tijd. v. Gen., May 9, 1925).

R. MAX GOEPP,
Philadelphia.

PERNIO (CHILBLAIN; TRENCH FOOT; FROST-BITE).

—Pernio is a pathological condition of the skin due to damp cold. During the war it was known as "trench foot;" it caused much hardship.

SYMPTOMS.—In mild cases there is slight redness, swelling, itching, and burning of the part. These symptoms all become intensified in severe cases, and the inflammation may be so great that vesication and ulceration result.

Chilblains may be followed by a general tumefaction of the regions attacked, which is the result of local asphyxia even more than of chilblains themselves. In the hands and toes this tumefaction gives a peculiar, sausage-like aspect to the parts, somewhat like that resulting from acromegaly. Localized and persistent vascular dilatations, true acquired capillary angiomas, studded with small papillomata may also occur.

As **trench-foot**, during the war, it occurred in three grades of severity: 1, painful anesthesia, edema and redness; 2, superadded phlyctenule and scars; 3, gangrene, often mutilating, followed by septicemia and sometimes death. Tetanus and gaseous gangrene are also observed. The third grade is encountered in about 1 per cent. of all cases in men who have been long in the trenches, particularly in certain trenches—a fact which has caused trench-foot to be regarded as a mycosis by some observers. Soldiers from warm countries and colored men were especially predisposed to it. There is less itching in trench-foot than in chilblain owing to the greater severity of the morbid process.

ETIOLOGY AND PATHOLOGY.

Defective or insufficient alimentation facilitates the development of chilblains; inactivity also assists; cold, aided by defective conditions of circulation and of functions of the economy, is their main cause. It exerts still greater effects when the skin is wet or not properly dried, or when it is suddenly succeeded by heat.

A slight increase of transudation converts the water-logging of the tissues into perfectly definite hematomata such as are seen in chilblains. The subjects of malarial cachexia are not infrequently also the sub-

jects of chilblains, which are also of very frequent occurrence in hemophilic families.

Trench-foot was mainly observed in men who in the trenches were subjected to prolonged standing, long immobility, fatiguing positions such as crouching, prolonged stays in boggy, flooded trenches, wet dug-outs and shell-holes. Another potent factor was the impediment to the venous circulation of the legs caused by that product of ill-advised military economy, the puttee. The Belgian soldiers, who were not provided with puttees, suffered with extreme rarity from trench-foot.

TREATMENT.—For chilblains, Sir A. E. Wright recommends measures to increase coagulability of the blood. **Calcium lactate**, 5 grains (0.3 Gm.) is indicated, also **cautioning** patients **against** lowering their blood coagulability by the **ingestion of sour fruits, alcohol, or excessive quantities of fluid.**

A solution of **acetate of zinc**, 1 dram (4 Gm.) to the pint (500 c.c.) of water, applied to the foot is said to give almost instant relief.

Codliver oil, preparations of **iodine, iron iodide**, and **arsenic** are indicated in all cases. Brocq recommends the association of **quinine sulphate** and of **ergotin** (in doses of from $\frac{3}{4}$ grain to 3 grains—0.048 to 0.2 Gm.) with powdered **digitalis** (from $\frac{1}{8}$ to $\frac{1}{4}$ grain—0.013 to 0.02 Gm.) and the extract of **belladonna** ($\frac{1}{2}$ grain—0.03 Gm.). Brocq recommends the following powder:

R **Bismuth salicylate** 10 Gm. (2½ dr.).
Cornstarch 90 Gm. (3 oz.).

As a preventive, friction with camphorated alcohol is useful. For the severe itching the following lotion may be rubbed in:—

R **Glycerin**,
Rose-water,
of each 50.0 Gm. (1½ oz.).
Tannin 0.10-1 Gm. (1½-15 gr.).

To preserve the hands one may also apply the following cream:—

R **Lanolin** 60.0 Gm. (2 oz.).
Oil of sweet almonds 50.0 Gm. (1½ oz.).
Petrolatum 0.001 Gm. ($\frac{1}{60}$ gr.).
Essence of rose . 10.0 gtt. (10 drops).

Regular exercise, walking, gymnastics, cold affusions, and general stimulating lotions represent extremely useful prophylactic means in the majority of subjects. The hands should be covered with thick and sufficiently warm gloves, but rough woolen gloves should be avoided. They, like the feet, should be washed in warm water (not in cold) and carefully dried on a towel (never before a fire), and then powdered with starch or talc in order to remove every trace of dampness. The hands should not be allowed to remain too long in cold or soapy water.

Shoes and stockings should be comfortably large; they should be thick enough to protect the feet against the action of the cold. If sweating accompanies the chilblains, repeated foot-baths must be resorted to. Foot-baths containing small quantities of astringent decoctions of walnut-leaves, of ash-leaves, of eucalyptus-leaves, of oak-bark, etc., of from five to six minutes' duration, constitute a very useful means of preventing frost-bite.

When the lesions are due to hyperemia with little or no infiltration of the skin, zinc-oxide ointment, such as the following, to which has been added a small quantity of carbolic acid or menthol, will suffice to allay the pruritus and cause the rapid disappearance of the lesions:—

℞ Zinc oxide 150 gr. (10 Gm.).
Phenol 8 gr. (5 Gm.).
Petrolatum,
Lanolin, of each 225 gr. (15 Gm.).

M.

If there is active inflammation, the preferable treatment is with an ointment containing lead salts, such as the following:—

℞ Lead subacetate . 30 gr. (2 Gm.).
Carbolic acid ... 8 gr. (0.5 Gm.).
Zinc oxide 225 gr. (15 Gm.).
Petrolatum,
Lanolin, of each 300 gr. (20 Gm.).

When chilblains resist these topical applications, ointments containing silver nitrate, or painting with 50 per cent. solution of silver nitrate or with the tincture of iodine, often hastens their resolution.

If blisters form they should be opened aseptically and covered with a dressing of petrolatum and boric acid, or with freshly

prepared carron oil to which has been added 2 per cent of carbolic acid. If these blisters have been ruptured, or the chilblains are ulcerated, after bathing the parts with a weak solution of corrosive sublimate they should be covered with a dressing of petrolatum and boric acid, or with non-irritating plasters, such as zinc oxide, simple boric acid, and dermatol plasters, or Vidal's red plaster.

When the ulcerations do not disappear they should be touched every two days with a silver-nitrate stick, or with tincture of iodine, and dressed with camphorated brandy, with Van Swieten's solution diluted one-half with water, or with aromatic wine. These dressings should be carefully applied, particularly on the toes and between the fingers, where, according to Besnier, it is well to place small tampons of absorbent cotton.

Boeck states that resorcin is efficacious in treatment of chilblains, especially when associated with ichthyol and tannic acid, as follows:—

℞ Resorcin,
Ichthyol,
Tannic acid, of each 1 part.
Water 5 parts.

The affected parts are painted with this liquid every evening, the bottle being well shaken before using. It can only be used for the feet, as it blackens the skin. It can, however, also be used for the hands by omitting the tannic acid.

Trench-foot.—The prevention of trench-foot includes the elimination of the band puttee and the wearing of boots permitting free circulation of feet and legs, and freely greased to prevent penetration of the leather by water. Measures to provide the men with dry shelters. Careful cleansing of the feet and greasing of socks; frequent changing of latter. Well greased foot rags well paraffined are more comfortable than socks unless the latter are whole and fit well, though loosely. The use of trench-foot wash-houses where the feet are soaked with a solution of soft potash soap 1000 parts, powdered camphor 25 parts, and sodium borate 100 parts, then dried and dusted with a powder composed of camphor, talc and sodium borate has proven effective. Warm food and bever-

ages should be served to men in the trenches to sustain the general circulation.

The medical treatment for milder cases is similar to that for ordinary pernio. Tepid foot baths with borated camphorated soap, followed by large borated camphorated dressings. In the more severe cases, recumbency for 2 to 3 weeks, with the feet elevated, is advised. For pain, 2 grains (0.12 Gm.) of acetphenetidin and 7 grains (0.45 Gm.) of sodium salicylate 3 times a day are useful (Bell). Potassium iodide internally has been found valuable by Sweet, Norris and Wilmer. S.

PEROXIDE OF HYDROGEN.

See HYDROGEN DIOXIDE.

PERTUSSIS (WHOOPIING-COUGH).—DEFINITION.—An acute infectious disease characterized, at the onset, by catarrhal symptoms of the upper respiratory passages, and, toward the end of the second week by a peculiar convulsive “whoop” or crowing inspiration.

SYMPTOMS.—Pertussis develops after a variable incubation period of from 5 to 13 days, and may conveniently be divided into three stages: the catarrhal, the paroxysmal, and the stage of decline.

Catarrhal Stage.—The symptoms of this stage are those of a more or less severe coryza, which at the onset is unable to be distinguished from that due to other diseases. The cough at this period is not characteristic; gradually, however, it assumes a paroxysmal character and is more frequent during the night than is the case with a cough due to ordinary causes. At this stage it is seldom that any adventitious sounds are to be heard in the chest. There may be slight fever and a dry cough which is not arrested by the usual remedies.

Paroxysmal Stage.—This develops toward the end of the second or dur-

ing the third week. The cough then becomes more violent and paroxysmal, and is characterized by the crowing inspiration termed the “whoop.” The child recognizes its oncoming and endeavors to suppress it, or runs to its mother or nurse for support; a series of quickly repeated short coughs burst forth and persist until the chest is in a state of extreme expiration. The effort seems to be exerted mainly toward this and the expiration muscles so vigorously brought into play that the chest is compressed laterally, the sternal region being thus made to bulge out. The face becomes congested and cyanotic, and the eyes suffused and perhaps injected. Then follows the long-drawn inspiration accompanied by the characteristic “whoop.” This may be repeated two or three times. The paroxysm generally ends with the expulsion of a large quantity of clear, thick, tenacious mucus from the upper part of the throat. Vomiting, with complete unloading of the stomach, frequently takes place at the same time. In delicate children, and especially in infants, these paroxysms produce great exhaustion, and the little patient falls back with livid face and pulse almost uncountable; the great strain may also induce tenderness of the respiratory muscles. In some instances the paroxysm is sufficiently severe to cause epistaxis and other hemorrhages, external and internal.

These paroxysms occur at intervals varying according to the period in the disease and the severity of the attack. In mild cases 8 or 10, in severe cases 20 or 30, may occur during the twenty-four hours. Their severity is also variable. Both the fre-

quency and severity of the spasms are greatest during the first two weeks of the spasmodic stage, after which they gradually lessen. In some undoubted instances of the disease the characteristic whoop is quite absent.

Stage of Decline.—This initiates the period during which the paroxysms grow less frequent, to finally cease. In some cases, however, this stage is protracted and is followed by anemia and prostration.

The disease generally runs a longer and more severe course during the late autumn and winter months than during the spring and summer. Impure air, cool draughts of air, and the recumbent posture are apt to increase the frequency and severity of the spasms. The usual duration of the disease is from 2 or 3 weeks to 8 or 10; occasionally it lasts for several months. The presence of adenoid vegetations in the nasopharynx adds to the severity and duration of an attack.

The disease sometimes attacks persons of adult age; in such the spasms may be severe, though the whoop is seldom characteristic. Complications are infrequent in adults, though the patient may be left with a peculiar laryngeal sensitiveness attended by cough under the influence of smoke, loud talking, etc.

COMPLICATIONS AND SEQUELÆ.—More or less tracheitis is present, which, under defective hygienic conditions or undue exposure, readily becomes converted into a bronchitis, adding to the violence of the symptoms. The case becomes still more serious if bronchopneumonia appears: a condition indicated by a sudden rise of temperature and

increased dyspnea. This complication adds greatly to the fatality of the disease. Some emphysema of the lung is probably developed in every serious case; a few instances have been noted where emphysema of the cellular tissue of the mediastinum has occurred: a condition which may go on to general subcutaneous emphysema and death. The digestive system is in every case apt to be more or less deranged; vomiting in some cases is a troublesome complication, and may interfere with necessary nutrition. A catarrhal condition of the intestines producing diarrhea is liable to occur in infants during the summer months.

In all children an attack of pertussis appears to induce an increased irritability of the spinal and cerebral centers.

Convulsions are very liable to occur, due in some instances to merely temporary causes; in others to serious cerebral lesions such as intracranial hemorrhage or thrombosis, and followed by more or less extensive paralysis, and sometimes by disturbances of sight and hearing. Hemorrhage due to mechanical causes is not infrequent; epistaxis occurs frequently; subconjunctival hemorrhage is more rare; intracranial hemorrhage is generally meningeal, intracerebral being distinctly less frequent.

Among the more important sequelæ of the disease are various chronic pulmonary affections: emphysema, chronic bronchitis, asthma, atelectasis, and chronic interstitial pneumonia. It is to be remembered also that after an attack of whooping-cough has run its course latent tuberculosis and syphilis may suddenly show indications of activity, the heart

may show signs of overstrain, and a condition of undue nervous irritability may persist for several months. (Blackader.)

DIAGNOSIS.—The early catarrhal stage being in no way characteristic, it is difficult, except in those cases in which direct exposure is known to have occurred, to distinguish between pertussis and a catarrhal condition arising from other causes. When the paroxysmal stage is reached, the spasmodic character of the cough, its frequency and severity during the night, the suffusion of the eyes, and puffiness of the lower lids, are all suggestive symptoms, but not absolutely diagnostic. Slight ulceration of the frænum linguæ, due to the violence of the cough, frequently occurs in young infants in whom the incisor teeth have been cut.

A study of whooping-cough in 442 infants less than 1 year old brought out the absence of the whoop in such young infants. The typical symptoms are great restlessness, with rapid respiration and frequent interruptions with cough while crying. The infants throw their arms about, bump their heads against the crib, and scratch their faces. Paroxysms of sneezing or even yawning may be substituted for whooping-cough paroxysms. An emphysema partially covering the heart may be observed on fluoroscopic examination. It is important not to wait for the whoop before isolating young infants; otherwise, an epidemic may be started. Düsseldorf Clinic (Zeit. f. Kind., Sept. 28, 1925).

A paroxysmal cough closely resembling that of whooping-cough may be induced by *enlargement of the bronchial glands*. In early infancy laryngeal spasm producing stridor closely resembling the whoop of pertussis may be due to a *catarrhal laryngitis*.

Cases of *spasmophilic pseudopertussis*. One child had symptoms of whooping-cough whenever it was given whey. Another had typical attacks although it had had whooping-cough 6 months before. The attacks were overcome by the administration of calcium, and returned when the latter was stopped. Wernstedt (Acta ped., Oct. 22, 1925).

Of diagnostic value is a differential blood-count, pertussis being characterized by a preponderance of lymphocytes, which sometimes reaches as high as 50 or 60 per cent. The polynuclears may be doubled in number. The specific gravity of the urine is high and the urine contains considerable uric acid.

According to W. Schneider, the general leucocytosis reaches its height about the third week, the total count being about 27,000. In one case, a count of 85,000 was found. The lymphocytes are relatively increased during the first four weeks of pertussis, the average being between 58 and 63 per cent. The large mononuclears and transitionals also show a slight increase, the count equalling 6.2 per cent.

Stress laid on lymphocytosis, as a useful aid in the early detection of whooping-cough. To simplify the procedure, both the small and large lymphocytes and the transitionals are counted together as lymphocytes; the total leukocyte count is dispensed with. A blood smear is taken from each case and stained with Jenner's fluid. Out of 124 clinically positive cases, 65.5 per cent. showed a very definite relative lymphocytosis. Out of 84 suspicious cases which later proved to be pertussis, seen within the first 2 weeks of the infection, 82 per cent. showed a very definite lymphocytosis, while of 57 suspicious cases which later proved not to be pertussis, only 10 to 17 per cent. showed lymphocytosis. The writer deems isolation justifiable on the basis of a suspicious cough with lymphocytosis. H. Heiman (Arch. of Ped., June, 1924).

The complement deviation test of Bordet is believed to reveal even mild cases which, nevertheless, are capable of propagating the disease.

The **complement-deviation test** is of the very greatest value in the diagnosis of whooping-cough, though Bordet himself, who described the bacillus, concluded that the complement-fixation was not an early sign. The writers' technique for the test is described thus: A small amount of blood was taken from the patient's ear, finger or toe in small test-tubes, or the Wright capillary tubes. This was kept at room temperature or placed in the incubator until coagulation had taken place. Serum was then separated more completely from the clot in the centrifuge. Only the fresh active serum was used. Two drops of the serum were used in each test. Hemolytic System: The Noguchi system was used, because of its extreme delicacy and because of the small amounts of material, especially serum, required. Antigen: This is the most important factor in the test. The Bordet-Gengou bacillus was obtained in pure culture from the laboratories of Parke, Davis and Co. Most of the work was carried on with this culture. Subcultures were made on Bordet's medium, ascitic fluid agar, and broth serum. The antigen was made from seventy-two-hour growths in ascitic fluid agar in the following manner: The colonies, which are very tenacious, were washed off the agar with sterile salt water. An emulsion was made, and the bacteria again washed in salt water. From this a standard suspension was made and 0.1 and 0.2 c.c. of this used in the test. Throughout the tests live bacteria were used. Controls: In each test known normal and known positive controls were used. In each series of tests the hemolytic system was tried out in the usual manner, using a water-bath at 37° C. for incubation. After primary incubation for half an hour the amount of amboceptor indicated by the preliminary test was added to

the final test-tubes, and the tubes again incubated in the water-bath. Final readings were taken within the following hour. The writers call special attention to the need of fresh antigen in the test. A. Friedländer and E. A. Wagner (Jour. Amer. Med. Assoc., March 28, 1914).

An early diagnosis may be obtained by cultivating pertussis bacilli in a glycerin-potato-agar medium, but the procedure is unreliable with negative findings. E. Best (Arch. f. Kind., Dec. 24, 1924).

A definitely acid reaction in a suitable medium is favorable for the isolation and growth of *B. pertussis*. It is especially valuable because it inhibits the growth of *B. influenza* and other organisms found in the sputum of patients with pertussis. The most favorable point of acidity for isolation was pH 5. The limits of acidity favorable to the growth of *B. pertussis* are pH from 6.1 to 4.4. Povitzky (Jour. of Inf. Dis., Jan., 1923).

The principal aids in the early diagnosis of pertussis are the presence of a relative and absolute lymphocytosis in the blood; the presence of the Bordet bacillus in the sputum, and a positive complement fixation test. The cutaneous tests have not proved of any value. There occur cases of pseudo-pertussis. The term pertussis should be restricted to an acute infectious and communicable disease, caused by the Bordet-Gengou bacillus. C. Herrman and T. Bell (Arch. of Ped., Jan., 1924).

ETIOLOGY.—The fact that pertussis is highly communicable points strongly to the existence of a specific organism to which the catarrhal and nervous symptoms may be more or less directly attributed. The Bordet-Gengou bacillus is being increasingly accepted as the cause of the disease. It is found in great numbers in the cilia of the superficial epithelial cells, causing local irritation and cough in the respiratory area.

On intraperitoneal injection in mice, the Bordet-Gengou bacilli, as a rule, cause a lethal bacteremia. This distinguishes them from the influenza bacilli, which are not thus pathogenic, though culturally and serologically not to be differentiated from the pertussis organism. The Bordet-Gengou bacilli were found regularly in whooping-cough, particularly in its early stage, even previous to the beginning of the clinical symptoms. Their virulence in mice showed a definite correspondence to the severity of the case of pertussis yielding them. Bachmann and Burgard (Zeit. f. Kind., July 24, 1925).

The contagium is thrown off from the respiratory tract, chiefly in the sputum; the disease appears to be readily communicated through the air even for a considerable distance, and appears to be specially contagious during the early catarrhal stage.

Like other infectious diseases whooping-cough generally occurs in epidemics, which are more frequently met with during the spring and autumn months, and in a peculiar way are frequently associated with epidemics of measles, and often precede or follow epidemics of scarlet fever. The majority of cases occur in children under the age of 4 years; it is seldom met with in children over 12 years; in early infancy it is peculiarly severe and fatal. Girls seem to be more readily infected than boys, though very few children who have not been rendered immune by a previous attack of the disease escape it when exposed to contamination.

PATHOLOGY.—In simple, uncomplicated cases slight catarrhal inflammation of the nose, pharynx, larynx and trachea down to the bifurcation may be observed. In severe cases the inflammation may extend to the smaller bronchi. The source

of the cough is probably the cough area in the interarytenoid region, which is usually markedly congested. In fatal cases the tracheal and bronchial glands are found enlarged; more or less extensive catarrhal pneumonia is generally present; frequently we find collapse of lung with associated emphysema.

In going over sections from an acute case of whooping-cough the writer noticed what seemed to be minute organisms packed in large numbers between the cilia of the epithelial cells lining the trachea. Better sections and stains showed the organisms to be minute bacilli, present in great numbers over the surface of each cell. Similar organisms were found between the cilia of the cells lining the bronchi, also free in the bronchial secretion and inclosed in polymorphonuclear leucocytes, but never in the alveoli. The bronchopneumonia is due to contaminating organisms. The action of the *Bacillus pertussis* seems to be largely mechanical. It interferes with the normal movements of the cilia and therefore furnishes a continual irritation which excites the coughing. The organism also secretes a mild toxin, as is shown in three ways: By a slight inflammatory exudation, by a lymphocytosis, and by the production of a specific antibody. F. B. Mallory (Boston Med. and Surg. Jour., Sept. 11, 1913).

The sputum from 156 Copenhagen children with whooping-cough showed the presence of the Bordet-Gengou bacillus in all who had been coughing for 2 weeks; in two-thirds of those who had had the paroxysmal cough for 2 weeks; in one-third after 3 weeks, and only in 3 out of 36 in the fourth week, and only once later than this. Comby (Archives de Méd. des Enfants, Nov., 1917).

PROGNOSIS.—Pertussis is not the benign disease that laymen believe it to be. In point of mortality

it stands third among the diseases of children. It is more than twice as fatal among negroes as in whites. It is more to be dreaded during the winter and early spring months than during summer. The mortality is especially high when an attack appears during early infancy, especially in rachitic or tuberculous children, or in children suffering from adenoid growths in the nasopharynx. The disease assumes a specially fatal character in foundling asylums and hospitals, where bronchopneumonia of a severe type is liable to develop. In children over six years of age, serious complications are rare.

Whooping-cough, with a mortality of about 7 per cent., and a toll of 10,000 in the United States annually, presents an appalling contrast to the layman's and the average physician's idea of its harmlessness. Eight cases are reported, of which 7 were fatal, and 1 patient lived, but required unremitting care for a year and a half, at the end of which time she presented no great promise of physical or mental development. P. H. Sylvester (*Boston Med. and Surg. Jour.*, March 19, 1914).

The prognosis in pertussis depends on the age of the child and on the presence or absence of pulmonary complications. There are more deaths among females than among males. Eighty per cent. of all deaths occur in children under 2 years of age. The greatest mortality occurs in the late winter and early spring, and is largely due to intercurrent catarrhal infections which cause pneumonia. In a series of 297 cases, 90 per cent. of the deaths were due to a complicating pneumonia. Fourteen per cent. of the series developed bronchopneumonia, and the mortality in patients with pneumonia was 18 per cent. The mortality in those who had pertussis and measles was 30 per cent. The earliest and most characteristic change in patients

with bronchopneumonia is the presence of localized fine resonant râles at the base or at the angle of the scapula, especially on the left side. The susceptibility and unfavorable course of pneumonia in infants is probably due to immunologic, not to anatomic, peculiarities. There is no conclusive evidence that pertussis is an important factor in the causation of pulmonary tuberculosis. Herrman and Bell (*Arch. of Ped.*, Jan., 1924).

PROPHYLAXIS.—The child should be **isolated and kept from school**. Young and delicate children, especially if predisposed to tuberculosis or if they have adenoid vegetations, are particularly sensitive to infection and are prone to have the disease in a violent form.

Rooms occupied by a case of pertussis should always be subjected to a **prolonged airing**, and preferably to **fumigation**, if they are to be occupied by a child. All children in a house in which a case of pertussis has developed should be taken away if feasible, and should be **kept in the open air** as much as possible, though not exposed to cold or weather inclemencies. The **quarantine should continue until the paroxysmal stage is past**.

In New York the district nurses are required to visit and revisit pertussis cases in common with measles, scarlet fever, and diphtheria, and to leave cards of instruction with the family. If there is a private physician in attendance the nurse does nothing further, but instructs the family to keep the child in quarantine and isolated for one week after the first day on which the "whoop" appears. No placards are posted. In families where, in addition to the sick child or children, there are infants or very young children, care is taken to explain the danger to the latter. Failure to secure observation of isolation is followed by a warning from one of the

health-squad patrolmen. One week after the first appearance of the "whoop," permission may be given for the sick child to leave the premises, *provided it is accompanied by an adult who will see that the child does not play with other children, enter other homes, attend places of amusement, or ride on street cars, etc.* Children can play in the yard or on the roof, provided no other children are there. (N. Y. Med. Jour., Oct. 24, 1914).

A vaccine prepared with the Bordet-Gengou bacillus has been employed for prophylactic purposes. One, 2, and 3 billion organisms, respectively, are commonly injected at three-day intervals. Injections of **convalescent serum** or of **whole blood** from persons who have had whooping-cough also constitute an available measure.

In 40 subjects exposed to pertussis in their families, the writer gave 3 injections of 2 or 3 c.c. of a vaccine made from 4 strains of the Bordet-Gengou bacillus (*B. pertussis*) and containing 2 billion bacteria per c.c. The 3 injections were given in a period of 6 days. Thirty-eight remained well, while 2 who were treated during the incubation period developed slight symptoms. The immunization was verified by complement fixation, agglutination, and opsonin tests. Auricchio (Policlin., Jan. 1, 1923).

The Bordet-Gengou vaccine is effective in prophylaxis provided the Bordet-Gengou bacillus is present in the initial cases. If this bacillus is absent, the author uses an **autogenous group vaccine** obtained from cultures of the bacteria found in the respiratory tract of the first patients. The results appeared encouraging. Z. von Bokay (Jahrb. f. Kind., Aug., 1924).

In a comprehensive study of reports from hospitals, general practice, children's homes, etc., the great majority were found to indicate that **vaccine** given *during* or *prior* to incubation tends to prevent the disease, and that advantage resulted in many cases when the vaccine was given in the catarrhal

stage or the first week of the paroxysmal stage. The authors recommend intramuscular injection and larger doses given more frequently. A. H. Meyer, M. Kristensen and E. Sørensen (Acta ped., Oct. 25, 1924).

Four exposed children were given by subcutaneous injection 2 to 5 c.c. of **whole blood** from persons who had had pertussis long before. None developed the disease. In 2 other children, injected during the catarrhal stage, the disease appeared in a mild form. The same results were obtained in 6 normal children and in 5 children already in the catarrhal stage who received whole blood from parents without a history of pertussis. Gillot (Bull. de l'Acad. de méd., Feb. 10, 1925).

TREATMENT.—Careful **hygiene** and judicious management do much to lessen the number and severity of the spasms and prevent complications.

The patient should breathe a **pure air**, not too dry, the temperature of which should not be allowed to vary much from 65° F. (18.3° C.). As much time as possible should be spent **out of doors**. Older children with pertussis may even go out on fine days during the winter. **Cold draughts, strong winds, and sudden atmospheric changes** are to be **avoided**, however, as liable to increase the catarrhal conditions present and give rise to severe pulmonary complications. When the patient cannot be out of doors, owing to climatic conditions, it is well to confine him strictly to two rooms, one of which should be thoroughly aired while the other is occupied. A change of rooms and even of clothes, bedding, etc., sometimes proves very beneficial.

When the cough persists, a **change of climate** is desirable, a warm **seashore** location where the child can be

out of doors continuously being preferable. A **sea-voyage** is particularly beneficial to hasten convalescence.

Nutrition must be maintained; the **diet** should be **nourishing**, but **simple and digestible**. If vomiting occurs frequently, food must be given in small quantities and at short intervals; in young children a **milk diet** may be ordered. **Excitement** of all kinds is to **be avoided**. The patient should be instructed to cough as little as possible.

Stress laid on reducing the profuse secretion, this in turn reducing the paroxysms. The author advocates **restriction of proteins and fats**, free ingestion of **water**, starvation for half the day every 5th to 8th day, and a mild **calomel** or **saline purge**. Dobeli (Schweiz. med. Woch., Mar. 10, 1921).

Gastric lavage twice daily before meals advocated. For the lavage the writer uses 2 quarts of water at 100° F. containing 20 minims (1.25 c.c.) of **lysol**, in alternation with 3 to 4 drams (12 to 16 Gm.) of **sodium bicarbonate**. A Türk's double stomach tube is employed. The **diet** is restricted to quickly digested food, excluding plain milk, though **malted milk** may be given. He reports 8 cases cured in 3 to 6 days. The spasms are attenuated after 1 day's treatment, and if the procedure is begun early, 3 days' treatment ends the cough. T. P. Hall (N. Y. Med. Jour., Aug. 2, 1922).

In pertussis in *infants* **open air** treatment and **breast milk** are the chief measures to be depended on. **Fluid restriction** assists in reducing secretion. Feeding with **thick gruel** 4 times a day also helps by allowing the stomach to contract, thus relieving any pressure on the diaphragm and respiratory organs, and by reducing the tendency to vomit. Coughing spells are shortened by **stretching the neck** by lifting the chin. In pneumonia consequent on pertussis **venesection** often helps the patient through the danger period. **Vaccine** seems to assist in

aborting the disease, when taken early. Düsseldorf Clinic (Zeit. f. Kind., Sept. 28, 1925).

Local Measures.—Many attempts have been made to modify the course of an attack by the topical application of antiseptics. Moncorvo has claimed much benefit from the application of a 1 or 2 per cent. solution of **resorcinol** to the nasal passages, pharynx and larynx by means of a brush or spray.

Nasal insufflation of powders, the introduction of ointments (6 to 20 per cent.) or sprays containing **quinine**, or local application of a **silver nitrate** or an **iodine** solution have also been recommended. The great objection to such measures is that every application is resisted by young children.

Ochsenius applied **silver nitrate** in 2 per cent. solution to the throat in 95 early cases, to prevent spread of infection downward from the pharynx. It proved useful in 84 instances. Mucous secretion was prevented, and coughing spells due to irritation by secretion minimized. The solution was applied daily at first; later, on alternate days.

Iodine recommended, as follows:—

R *Iodi* gr. xv (1 Gm.).
Potassii iodidi,
Aquæ destillatæ,
 āā ʒss (15 Gm.).
 M. et ft. solutio.

This solution is given in sweetened milk in daily (fractional) doses of 4 to 6 drops for infants a year old, 6 to 10 drops for children 2 to 5 years old, and 10 to 15 drops for older children. No phenomena of intolerance ever appear. Where indicated, **quinine** and **bromides** can be added. Cavazzani (Jour. de méd. de Paris, Sept. 13, 1913).

The writer swabs the pharynx with a 2 per cent. solution of **resorcinol** in glycerin and water, 1 and 12 parts. Macleod (Lancet, Feb. 15, 1919).

The **silver nitrate** treatment locally is recommended by the author, together with **intranasal instillations** of 2 per cent. **colloidal silver** solution followed by **insufflations of anesthesin** through the nasopharynx. These measures are used 3 times daily. The analgesic action of the anesthesin is held to be useful in counteracting inflammation. Ochsensien (Monatschr. f. Kinderh., Oct., 1922).

The inhalation of an **antiseptic vapor** has been widely advocated. **Creosote** is the most effective, but **phenol**, **eucalyptol**, and **thymol** are also useful. A solution of either, 1 dram (4 Gm.) to the pint (500 c.c.) of water, may be readily volatilized by heat and its vapor be diffused through the air and inhaled unconsciously by the little patient. By this method one obtains not only an antiseptic but an anesthetic action on the respiratory passages, and can unquestionably lessen the frequency and severity of the spasms. The best results are obtained when the patient is made to breathe a strongly charged atmosphere for one or two hours two or three times a day; but caution must be exercised lest irritation of the kidneys be induced. Inhalations of **oxygen** and **ozone** have also been lauded.

Systemic Medication.—Sedative and antispasmodic medicines may be given internally with the object of allaying the nervous irritation and checking the spasm. Among the most generally employed are the **bromides**, **belladonna**, **antipyrin**, and **chloral hydrate**. **Antipyrin** is the best of these and may be given in 1-grain (0.065 Gm.) doses to a 6 months' infant, or in 2-grain (0.13 Gm.) doses to a 2-year-old child. It should be discontinued if pneumonia or bronchopneumonia develops. It may be advan-

tageously combined with **sodium bromide**. **Diacetylmorphine** (**heroin**) has been praised by some clinicians.

Bromoform has been strongly recommended by many writers. It is generally given in alcoholic solution made into an emulsion with gum arabic and syrup, but much caution must be exercised, as the bromoform is liable to be precipitated and thus be present in poisonous amount in the last doses in the bottle. The latter should always be well shaken. A better plan is to order it to be **dropped on** a lump of **sugar** and given in this way to the child. It is not suitable for young infants. One to 3 drops may be given to a 2-year-old child. Caution should be exercised in the use of large doses.

Benzyl benzoate used in doses of 5 to 30 minims (0.3 to 1.8 c.c.) every 4 hours, with asserted good results. The treatment usually caused subsidence of the paroxysms. McMurray (N. Y. Med. Jour., July 24, 1920).

Belladonna has been recommended. Starting with small doses, $\frac{1}{4}$ minim (0.015 c.c.) of the fluidextract, or **atropine**, $\frac{1}{800}$ grain (0.00008 Gm.), may be used in a child of 2 years, every four hours. The dose is slowly increased, the effects being carefully watched. If the physiological effects of the drug are noted, the dose is then reduced.

The writer prefers the **tincture of belladonna**, beginning with 1 drop three times a day, and increasing the daily quantity by 1 or 2 drops until mild physiological effects of the drug appear, when the increasing of the dose must be cautiously continued.

A single dose of **antipyrin** at bedtime or a morning and evening dose has been found best. To a child 2 years old, 2 or 3 grains (0.12 or 0.2

Gm.) each night, or morning and night, may be given. **Sodium bromide**, 5 grains (0.3 Gm.) three or four times a day, to a child of 3 years, is often efficacious, and **codeine**, **trional**, **heroine** and **chloral** are often of benefit in allaying cough and inducing sleep. They may be given in a single dose at bedtime, or, if necessary, two or three times a day. **Quinine lactate**, 10 Gm. (2½ drams), in **saline solution**, 100 Gm. (3½ ounces), may be used. Of this 2.5 c.c. (38 minims), warm, are injected intravenously. Graham (Arch. of Pediat., Aug., 1914).

Quinine is of advantage, but only after the fourth or fifth year, as it produces emesis in the younger children. Large doses are required, *viz.*, 1 to 1½ grains (0.06 to 0.1 Gm.) per year of age, four times daily.

In an epidemic witnessed by Andalo, the disease seemed to be aborted whenever **quinine** was given in large doses systematically for several days and retained. He always found exceptional tolerance for quinine in children. When necessary he injected daily 7½ grains (0.5 Gm.) of **quinine dihydrochloride** in infants and 15 grains (1 Gm.) in children up to the age of 5. On cessation of the tendency to vomit he gave the drug by mouth and kept it up for 8 or 10 days, by which time the disease had usually completely subsided. According to Senftleben, **quinine** and **antipyrin** can be depended on to abort or attenuate pertussis, and when accepted with difficulty by the mouth, may be administered by rectum.

Perrin and Remy obtained good results from the following:—

R *Methylis salicylatis* ʒj (30 c.c.).
Olei eucalypti ... ʒiii-v (90-150 c.c.).
 Misce.

The mixture was spread in a thin layer on plates or saucers and allowed to volatilize in the patient's room.

The writer considers **adrenalin** a specific when given as follows: Under 3 years, 2 drops every 3 hours; 3 to 7 years, 3 drops; 7 to 15 years, 4 drops; over 15 years, 5 drops, all given after coughing spells. If in 3

days there is no relief, 1 drop may be added per dose. Dumont (Tribune médicale, 55, No. 5, 1921).

Ether injections have been lauded by a number of observers.

Ether injected intramuscularly in 35 children in doses of 1 c.c. below and 2 c.c. above 1 year of age, daily or on alternate days. The results were classified as 17 recoveries, 9 improved, and 9 unimproved. From the first injection there was cessation of vomiting and reduction of fever and coughing spells. The drug may act as a tonic, antispasmodic, and perhaps also as an antiseptic (being eliminated largely through the respiratory tract) and a stimulant to phagocytosis. Magni (Riv. di clin. ped., May, 1922).

The author injects daily 1 c.c. (16 minims) of **ether** containing 0.05 Gm. (¼ grain) of **camphor**, or twice these amounts in older children. The measure seemed useful especially in the early stages. After 5 or 6 injections, the number of paroxysms fell from 18 or 24 a day to 6 or 8. Reim (Med. Klin., May 28, 1922).

Ether injections commended also in *bronchopneumonia* complicating pertussis. The author gives 0.5 to 1 c.c. (8 to 16 minims) into the gluteal muscles 2 or 3 times a day. Lo Presti-Semerio (Pediatria, Feb. 15, 1923).

Intramuscular injection of **ether** gave very good results. The duration of the disease was reduced to an average of 3½ weeks; the paroxysms to ½ after the first injection, and the whoop disappeared usually before the end of 3 weeks. Vomiting ceased after 1 or 2 injections. Any serious complication present was aborted. W. F. Drake (Ohio State Med. Jour., May, 1924).

Intramuscular injection of **ether** into the buttocks employed in 302 cases. Up to the age of 6 months, the writer injected 1 c.c. (16 minims) daily; above this age, 2, 3 or 5 c.c. (32, 48 or 80 minims) at a time on alternate days. The coughing spells became shorter and less severe, and there was no further vomiting after 1 or 2 injections. The disease was much shortened.

Complete cure was obtained with 2 to 8 or 10 injections. Pneumonia developed after the ether was given in but 1 case. He reports 250 cured; 35 improved, and 17 unmodified. G. Guinea (*Arch. españ. de ped.*, Oct., 1924).

Helpful also are **hot baths** and **mustard baths** as auxiliary measures during the paroxysmal stage.

Schrohe has always witnessed great relief follow a **warm bath** given toward evening. The water should be at about 99° F. (37.2° C.) and the child should stay in the bath for 10 to 15 minutes, the **head** being **kept cool with a cold water compress**. In two epidemics Althoff obtained marked success by the use of **mustard baths** and **menthol embrocations** over the spine, along with sedatives, chiefly **antipyrin**, **heroin**, and **sodium bromide**. This treatment must begin during the initial catarrhal stage to be efficacious, and then operates by curtailing the second or spasmodic stage.

Vaccines, both autogenous and stock, have been used in pertussis in a large number of cases, and appear to be of value in a certain proportion of patients. They are harmless and may be used in large doses, such as $\frac{1}{2}$ to 2 billion in children over one year of age.

The doses of **vaccine** hitherto used have been too small. The writer advocates an initial dose of at least 2 billion bacilli, increased to 12 billion. The duration in most cases has not been much under 6 weeks. From 400 cases he concludes that a certain number will respond favorably to the commercial vaccine. Early treatment is advised. H. S. Berman (*Mich. State Med. Soc. Jour.*, Aug., 1922).

The writer tried **serobacterins** in 85 cases of whooping-cough and deems them efficient. No harmful reaction or infection occurred. The earlier the vaccines were administered, the better the results. J. A. Henske (*Nebr. State Med. Jour.*, Jan., 1924).

Having tested the therapeutic use of **vaccine** in 65 cases and its prophylactic

use in 17 cases, the writer concluded that patients treated with vaccine after the onset of symptoms had slightly milder attacks, which terminated earlier than as outlined in textbooks. There was definite evidence that some cases were prevented by prophylactic treatment. The average duration of the disease was about 6 weeks with definite and lasting improvement beginning less than 4 weeks from the onset. C. A. Aldrich (*Amer. Jour. Dis. of Childr.*, Apr., 1925).

X-ray treatments, carefully administered, have been shown useful in diminishing the number and severity of the cough paroxysms.

Twenty-six cases given **X-ray treatment**. The ages ranged from 3 months to 40 years, and the cases were in varying stages of the disease. Three or 4 treatments at 2 or 3-day intervals were given, the total being well below an erythema dose. In some instances the spasms and whoops promptly disappeared. Most of the cases showed a gradual reduction in the paroxysms. H. I. Bowditch and Leonard (*Boston Med. and Surg. Jour.*, Mar. 8, 1923).

Roentgenotherapy, endorsed by the staff of the Boston Floating Hospital, is an excellent method for controlling the severe symptoms. In 400 treated cases, the average duration of the disease was 5.5 weeks; in 200 untreated cases, 8.7 weeks. Each child received 4 treatments unless immediate improvement followed the 2d or 3d treatment. The treatments were given on alternate days, anteriorly and then posteriorly. R. D. Leonard (*Amer. Jour. of Roentgenol.*, Mar., 1924).

In exposed cases, the use of pertussis **vaccine** may be considered as probably from 85 to 90 per cent. efficient in preventing the disease. In active cases, the use of the **Roentgen ray**, supplemented by **diathermy** and **medication**, is indicated, particularly in cases with bronchopneumonia. Bowditch, Leonard and Smith (*Amer. Jour. Dis. of Childr.*, Sept., 1924).

C. E. DE M. SAJOUS,
Philadelphia.

PETROLATUM. See PETROLEUM.

PETROLEUM.—Petroleum (rock oil, coal oil, mineral oil) is found in various regions of the world. In the natural state it varies in color from a light green or red to black, more rarely clear. It has a distinctive odor. Some specimens have a very offensive odor due to the presence of numerous sulphur and phosphorus compounds. Barbadoes tar, Seneca oil, and Rangoon oil are thick varieties. The Rangoon oil contains a larger proportion of both the olefin and the benzol series than American oil. It is soluble in fixed and volatile oils and in ether, in 64 parts of boiling absolute alcohol, but is nearly insoluble in water, and in chloroform. It is a solvent for india-rubber and many resins. By fractional distillation and purification, it yields a variety of commercial products, the lighter oils being used as solvents, the heavier being used for light, fuel, and lubrication.

All that portion which distills over at or below 122° F. (50° C.) is designated benzin, gasolene, or naphtha. Hydrocarbons of greater volatility are obtained from naphtha by repeated fractional distillation. Rhigolene is obtained by distillation from naphtha, distilling over at 64.5° F. (18° C.).

By distilling off the lighter and more volatile portions of American petroleum and purifying the residue, petrolatum, or petroleum ointment, is obtained. Petrolatum is an amorphous, pale-yellow to white, odorless, tasteless (or nearly so), transparent, fatty substance, more or less fluorescent. It does not become rancid, and is in most cases a valuable substitute for lard in the preparation of ointments. It can also be obtained as a semiliquid or liquid oil.

PREPARATIONS AND DOSES.—Petroleum (rock oil, crude petroleum), 15 to 30 minims (1 to 2 c.c.), as an intestinal antiseptic.

Petrolatum, U. S. P. (petroleum ointment; petrolatum molle, petrolatum spissum, Pharm., 1890).

Petrolatum album, U. S. P. (white petrolatum).

Petrolatum liquidum, U. S. P. (liquid petrolatum).

Benzinum, U. S. P. VIII (gasolene, petrol, petroleum benzin), 10 to 30 minims (0.6 to 2 c.c.) in mucilage or capsule.

Benzinum purificatum, U. S. P. (purified petroleum benzin).

Rhigolenum (rhigolene; used in spray for local anesthesia and thermocautery).

PHYSIOLOGICAL ACTION.—Petroleum when taken internally in small doses is stimulant, antispasmodic, diaphoretic, antiseptic, and expectorant. It disinfects the gastrointestinal and respiratory tracts. In large doses it gives rise to headache, vertigo, pain in the stomach, palpitation of the heart, vomiting, and tetanic spasm.

In petroleum poisoning a distinction must be made according as to whether the petroleum vapor is inhaled or the oil has been rubbed into the skin or has been taken internally. It would appear, according to Lewin's researches, that among workers in petroleum springs no ill effect is produced; that is, as long as the vapor is inhaled in the open air; but in factories similar symptoms are produced as by ordinary gas. A feeling of exhilaration is first induced, then heaviness in the head, vertigo, loss of consciousness, or anesthetic sleep. Cyanosis, contracted pupils, and vomiting may occur. Cutaneous hemorrhages, and hemorrhages of the gums, nose, the stomach, and of the genital organs are occasionally noticed. A fatal result may ensue. Chronic bronchitis with anemia may appear after long exposure to the vapor. Rats and dogs shut up in the fumes of gasolene die with symptoms resembling those occurring in man.

Petroleum applied to the skin may induce moderately serious symptoms. A diffuse inflammation of the cutis may occur in severe cases.

When petroleum has been taken internally the symptoms have not always been in proportion to the amount taken. There are two sets of symptoms: (1) gastrointestinal, the kidneys being also involved; and (2) nervous. In the former case there is vomiting as well as the local irritation in the mouth and gullet. Diarrhea, with colic, may supervene. The excreta are covered with oil. In the cerebral form there are headache, anxiety, vertigo, and the pulse is small and infrequent; collapse

and death from failure of respiration and circulation may occur. Tetanic convulsions have been seen. A marked petroleum smell has been noted in the sweat and also in the urine, which may sometimes smell of violets. The urine may also contain albumin and formed elements.

Treatment of Petroleum Poisoning.—Poisonous symptoms from the internal use of petroleum products demand the **evacuation of the stomach** by siphon or emetics, the exhibition of **stimulants**, and the application of **warmth and stimulants to the skin**. **Artificial respiration** may be necessary.

When poisoning follows the inhalation of the fumes, the patient should be removed to the **open air**, or at least to a **well-ventilated room**. **Strong hot tea** and other **stimulants** are indicated, as soon as the patient is able to swallow.

When poisoning occurs by absorption through the skin, the indications are to relieve the dermatitis through the use of **bland, emollient applications**.

THERAPEUTICS.—Internally the crude oil has been given in teaspoonful doses to children suffering with **whooping-cough** and **croup**. In **chronic bronchial disorders** it has seemed useful, given internally. Crude petroleum was at one time considered a specific against **phthisis**.

Hutchinson found that it possesses no value as a food. It is not absorbed, for after feeding healthy persons with it, he was able in every instance to recover the entire amount from the feces. It has been deemed useful, however, as a **protective to the intestinal tract** and as a vehicle for carbohc acid and other antifermentatives. As a gastrointestinal protective it may be given in capsules. Petroleum has been given as a vermifuge; 20 to 30 drops three times daily are said to expel **tape-worms**. In **cholera**, refined petroleum has been given with asserted benefit in doses of 10 to 20 drops in mint-water.

The inhalation of petroleum vapor has been recommended in **asthma**.

Sajous has found refined petroleum useful in **follicular tonsillitis**, applied with cotton pledget.

Petrolatum liquidum is useful in a spray in cases of **acute and chronic rhinitis**, as an emollient protective. It is also a desirable

lubricant for catheters, bougies, and other instruments. This preparation alone should be used for this purpose, as vesical calculi have been examined which seemed to have as a nucleus a small portion of petroleum jelly.

Liquid petrolatum (white mineral oil, sometimes termed "paraffin oil" or "liquid paraffin"—incorrectly, since it does not consist of true paraffins) has come into widespread use as a mild laxative in **intestinal stasis**, acting through softening of the feces, and remaining unabsorbed. The dose is 2 to 8 fluidrams (8 to 30 c.c.), $\frac{1}{2}$ hour before meals; or, 1 to 2 fluidounces (30 to 60 c.c.) on retiring. An oil of relatively high viscosity, with a specific gravity of about 0.890, acts best, less viscid oils tending to leak from the bowel (Russell and Brett). Occasional side-effects of liquid petrolatum are nausea and regurgitation.

Petrolatum is useful as a basis for ointments and as an emollient dressing for **sores** and **skin affections**.

Externally, refined petroleum, or head-light oil, may be used as a counterirritant in **chronic rheumatism**, **synovitis**, **sprains**, **chilblains**, and **paralysis**, and over the throat and chest in **inflammatory disorders of the throat and air-passages**. It is used alone or combined with other drugs in **chronic** and **parasitic skin diseases**; it has been found beneficial in **psoriasis**, **eczema**, **seborrhea**, **scabies**, **furuncle**, and **alopecia**.

Benzin (gasoline, petrol) is an excellent scalp cleanser, especially when **dandruff** is excessive. It is useful in **alopecia areata**, in **pediculi capitis**, for removing surgical dirt in cases of **scalp wounds**, in **pustular eruptions** about the beard, in **scabies**, **barbers' itch**, in cases of **fissured nipple**, **soft corns**, and **burns**, especially those produced by molten metals. For cleansing and disinfecting the skin previous to operation it is very serviceable, being free of irritating properties. Instruments and dressings may be sterilized by benzin.

Rhigolene is a very volatile product of petroleum. So very rapid is its evaporation that a spray of it will produce a local temperature of 15° F., and is used to induce local anesthesia. Rhigolene is the liquid employed for Paquelin's thermocautery. Its use near open lights is unsafe. It has an unpleasant, garlicky odor. W.

PHARYNX AND TONSILS, DISEASES OF.—ACUTE TONSILLITIS.—Acute tonsillitis, inflammation of the tonsils and adjacent structures, may be phlegmonous or croupous.

SYMPTOMS.—Acute tonsillitis is ushered in by a feeling of dryness and stiffness in the throat, soon followed by dysphagia. In phlegmonous tonsillitis there is a chill, or chilly sensations, and pain in the legs and back, headache, and fever, which during the height of the disease may reach 104° F. (40° C.). As the inflammation progresses, the sufferings of the patient become severe; the dryness of the throat causes frequent attempts at swallowing saliva, which are exceedingly painful. The mouth can be opened only with pain and difficulty, and speech becomes almost unintelligible. The tongue is heavily coated and the breath fetid. The hearing is frequently obtunded from extension of the inflammatory process to the Eustachian tubes, and abscess of the ear sometimes results. Nasal breathing is at times entirely abolished. The fever, pain, and difficulty of swallowing become greater and greater, if an abscess is forming, and the relief is proportionately great after it has opened. As the patient expectorates the pus, he feels almost well, so great is the sense of relief, the fever and pain quickly subsiding together.

ETIOLOGY AND PATHOLOGY.—An attack of *phlegmonous tonsillitis* (*peritonsillar abscess*; *quinsy*) is sometimes apparently the result of exposure to cold and wet; but a person who has once had the affection is more liable to subsequent attacks. Direct infection of a tonsil from

a diseased tooth or alveolar abscess has been observed. The rheumatic or gouty diathesis also plays its part in the production of attacks of acute tonsillitis. This is likewise true of chronic inflammation of the crypts of the tonsils, with accumulation of their secretions. It is by inoculation of the adjacent cellular tissue by such retained and decomposed masses that peritonsillar abscesses are caused, for abscess rarely occurs within the tonsil itself as the result of acute tonsillitis. Phlegmonous tonsillitis is a disease of adolescence and early adult life, and does not as frequently attack individuals who are over 35 years of age.

Occasionally acute tonsillitis is followed within a month by acute articular rheumatism, and it has been maintained that the points at which the bacteria causing rheumatism enter the system are the tonsils. However, there are many individuals who pass through a period of their life when they have many attacks of acute tonsillitis not followed by rheumatism, and only after ten or more years, during which they have had no tonsillitis, has the attack occurred. It seems probable that alveolar abscess and chronic infections about the teeth are more common causes of acute articular rheumatism or tuberculous cervical glands than are the tonsils.

In *croupous* (or *follicular*) *tonsillitis* the brunt of the inflammation is at first borne by the crypts of the tonsils, which pour out an abundant cheesy secretion, which, adhering to the surface of the tonsil, presents somewhat the appearance of a diphtheritic membrane.

Rarely are the lingual and pharyngeal tonsils involved. The disease is

the result of infection, but is contagious only to a very limited degree. It may result from any bacteria capable of producing a croupous pseudomembrane, the most common of such bacteria being the streptococcus and staphylococcus. In typical cases occurring in adults there is usually no difficulty in distinguishing by the unaided eye between the membrane of croupous tonsillitis and the white-gray or grayish-green, but sometimes yellow, and often semincretic membrane of diphtheria. In children diagnosis by the unaided eye is sometimes by no means easy. The struggles of the child may allow only a momentary glance at the parts and bleeding, which always occurs in diphtheria when an effort is made to remove the membrane, may also happen in the croupous tonsillitis of children. However, even in adults, an *absolutely positive diagnosis* between follicular tonsillitis and diphtheria cannot be made without the aid of a competent bacteriologist whose investigations should not only consist of the examination of smears and culture tests, but also inoculation experiments to exclude Hoffmann's bacillus, which resembles, in all respects except virulence, the Klebs-Löffler bacillus.

TREATMENT.—A thorough application of a solution of **nitrate of silver** of the strength of 1 or 2 drams (4 to 8 Gm.) to the fluidounce (30 c.c.) of water frequently aborts the attack, if applied early. The silver solution should be painted upon the tonsils and adjacent inflamed mucous membrane by means of a swab of cotton, and in croupous tonsillitis carried into the crypts after washing them out with **hydrogen dioxide**

by means of a modified Blake cannula. The relief experienced by the patient as the result of the application is almost instantaneous, and the application should be repeated once or twice a day until all inflammatory symptoms have subsided. The nares and pharynx should be washed by means of a spray from an atomizer containing **Dobell's solution** before making these applications, and a lozenge of **guaiaac and tannin** may be prescribed for the patient's use in the intervals between the applications. It is best also to open the patient's bowels thoroughly at the commencement of an attack by means of small, frequently repeated doses of **calomel**. When these measures do not succeed in aborting the attack, and the fever and suffering of the patient are constantly increasing, **aconite**, in drop doses of the tincture every hour or every two hours, will give most excellent results.

When pus has formed, the abscess should be opened by an **incision** through the soft palate just above the upper outer portion of the tonsil, the so-called point of election; or at a spot where the finger detects fluctuation. Even where no pus escapes from the incision, the bleeding affords a certain amount of relief, and may bring about resolution.

CHRONIC FOLLICULAR TONSILLITIS.

This affection is characterized by a feeling of fullness and discomfort in the region of the tonsils. Upon inspection the tonsils are perhaps redder than normal, and many of the crypts are filled with a cheesy exudate (cholesteatoma). The neighboring lymphatics are generally enlarged and tender to the touch.

TREATMENT.—The cheesy exudate should be carefully removed by **syringing** with normal salt solution by means of a syringe and a long, narrow nozzle, curved at the end. The nozzle is introduced to the bottom of each crypt, one after the other. After the tonsils have been cleansed in this manner, a fraction of a drop of **Batley's solution—iodine**, 5ij (8 Gm.); **phenol**, 5iv (16 Gm.); glycerin, f3vj (24 c.c.)—is injected into the bottom of each crypt by means of a hypodermic syringe with a long, fine, malleable silver cannula, and the **crypts slit open** with a suitably curved knife or scissors in such a manner that concretions are not easily retained.

In some instances the concretions are not located within the crypts, but between the tonsil and the plica triangularis, a triangular fold of mucous membrane extending from the anterior to the posterior pillar downward and backward across the tonsil, of which it covers the anterior lower third. Under such circumstances the **plica** is best **removed**, by introducing one blade of a curved scissors between the tonsil and the border of the anterior pillar and cutting downward as far as the space between the pillar and tonsil extends. The portion of the plica adhering to the tonsil is then removed with a **tonsil punch**. This simple procedure, sometimes termed "circumcision" of the tonsil, is practically bloodless and painless if the parts are first painted with 10 per cent. **cocaine** in 1:1000 **adrenalin** solution. It frees the tonsil from its attachments to the anterior pillar and the tongue in such a manner that tonsillar concretions tend to be squeezed from the tonsils by the action of the surrounding muscles

during deglutition. In adults it is sometimes as effective in preventing recurrent attacks of peritonsillar abscess as a tonsillectomy.

HYPERTROPHY OF THE TONSILS.

There are four varieties of chronic hypertrophy of the tonsils: First, the ordinary soft hypertrophy of the tonsils found in children and young adults; second, the so-called ragged tonsil; third, the scirrhus or hard tonsil, characterized by an enormous increase of the connective tissue of the gland and a canalicularization of its blood-vessels; fourth, the submerged or buried tonsil, where the hypertrophied tonsil does not project beyond the faucial pillars.

SYMPTOMS.—There is generally more or less obstruction to breathing, the patient snoring during sleep. The articulation is thick and there may be some difficulty in swallowing, especially in the cases of young children. The crypts of the tonsil may become filled with cheesy masses, which, undergoing putrefaction, impart to the breath an offensive odor. Hypertrophied tonsils also sometimes interfere with the proper performance of the functions of the Eustachian tubes and thus are the cause of aural catarrh and deafness.

TREATMENT.—In moderate hypertrophy without symptoms no treatment is required; on the other hand, **operation** is indicated where the enlargement is sufficient to interfere with speech, deglutition, or the functions of the ears, or if there are recurrent attacks of tonsillitis from infected crypts. Neither adenoids nor tonsils should be removed in infants unless they are unable to

nurse because of nasal obstruction. The teeth, periodontal spaces, and nasal cavities should be examined before accusing the tonsils, and when circumstances permit the operation is best postponed until the child is six years of age.

Tonsillotomy with the tonsillotome is performed as follows: The patient, if a child, should be seated in the lap of an assistant, who holds the child's legs between his own to prevent struggling. The assistant then passes his arms under the child's arms and grasps the child's forehead with his two hands so as to control the movements of the child's head. When the assistant elevates his elbows the child's arms are extended in such a manner as to prevent the child reaching his face with his hands and interfering with the operation.

The tonsillotome is then introduced into the child's mouth flat-wise, like a tongue-depressor, and serves to hold down the root of the tongue and afford a good view of the lower border of the tonsil. The ring of the tonsillotome is now passed around the tonsil from below in order to be sure that the lower border of the tonsil is encircled by the ring, which is pressed firmly against the wall of the pharynx. The blades of the instrument are now closed and tonsillotome and tonsil removed together from the mouth. If the operator is provided with two tonsillotomes it is generally feasible to remove the second tonsil before releasing the child, unless bleeding is so great as to interfere with a view of the fauces.

The operator should be provided with a set of at least three sizes of tonsillotomes, in order that he may

select one with a ring of just sufficient size to snugly fit around the tonsil to be removed. After encircling the tonsil the instrument should be closed somewhat deliberately, and the operator should be careful to make no effort to remove the tonsillotome from the mouth until the tonsil has been completely severed. The operation is not especially painful, and probably causes less discomfort to the patient than the administration of **ether**. However, there is no objection to administering ether for tonsillotomy. Under such circumstances the tonsils are removed with the child lying on its side and its head turned to one side, with the foot of the operating table elevated about three inches.

Tonsillectomy, or the complete removal of the tonsil, in contradistinction to tonsillotomy, or the removal of that portion of the tonsil projecting beyond the pillars of the fauces, is advocated by the larger proportion of laryngologists. Tonsillectomy is always advisable in submerged tonsils and in small tonsils with diseased crypts. Tonsillectomy can be done on docile adults after the injection of local anesthetics into the tissues, about the tonsils, but it is better undertaken under **etherization**. The position of the patient on his side and the elevation of the operating table is the same as for the removal of adenoids.

A mouth-gag is inserted, the tongue is held down and forward with a depressor; mucus and saliva are removed from the pharynx with a gauze sponge; the tonsil is grasped with stout volsellum forceps provided with a catch to render them self-retaining. The upper blade of the in-

strument should be in the supratonsillar fossa and the lower inserted into the lower border of the tonsil in such a manner that a part of the capsule and a considerable portion of the tonsil are included within the grasp of the forceps so that they will not readily tear out. The tonsil is now pulled strongly toward the median line of the pharynx, so that its extent beneath the anterior pillars is readily seen. While traction toward the median line is maintained, the anterior and posterior pillars are dissected loose from the tonsil by means of a tonsil knife, the tonsil being rotated downward and inward out of its bed or pushed or pulled away from the pillars to facilitate the procedure. Especial attention is directed to the attachment of the tonsil to the anterior pillar at the point where the plica triangularis leaves the anterior pillar to extend backward over the lower third of the tonsils. The capsule of the tonsil extends forward and medianly to attach itself to the edge of the anterior pillar at this point, and hence, severing this attachment, opens up the space behind the capsule and permits the tonsil to sag outward from its fossa toward the median line of the pharynx. The tonsil is now attached only by its lateral portion to its bed, from which it can be still further separated by the use of the finger-tip inserted into the supratonsillar fossa; better with Hurd's enucleator, a stout steel curette, slightly curved at the tip, which is about the size but much thicker than the forefinger-nail. The loop of a snare is now slipped over the forceps and made to surround the base of the tonsil, which by the use of the enucleator and finger-tip has become pe-

dunculated and adherent only at its inferior portion. As soon as the tonsil is enucleated its fossa should be filled with a small gauze sponge, either held in long, curved tonsillar hemostats or placed in position and firm pressure maintained with the fingers. After a few moments the wound should be inspected. Frequently it will be nearly dry or oozing at only a few points, which can be clamped with tonsillar hemostats or disregarded until the other tonsil has been removed, by which time the wound may have become entirely dry. When the patient is lying on the left side the left or lower tonsil is removed first, then the right or upper tonsil, and finally adenoids if any are present.

The entire operation can be done with forceps and Hurd's enucleator or other similar instrument, or even with forceps and the finger-tips. The objection to this procedure is the unnecessary traumatism and shock occasioned by the rough handling of the parts. It is far preferable to cut the small amount of cellular tissue binding the anterior and posterior pillars to the sides of the tonsils with a sharp, sickle-shaped knife, thus making a smooth cut through the mucous membrane and preserving as much of it as possible. The hemorrhage is so trifling that the parts are easily in view until the base of the tonsil is reached. Then when Hurd's enucleator is pushed underneath the tonsil, it serves to lift the tonsil and prevent the necessity of very hard traction with the forceps. It is sufficiently blunt to prevent much hemorrhage; not more than enough blood to stain a few sponges being usually lost unless the foot of the operating

table is raised sufficiently to cause congestion of the pharynx.

The attachment of the lower pole of the tonsil is often thick and tough, and while it can be torn through with the finger or an enucleator, it is better to cut it with scissors or a snare. For this purpose any snare large enough to carry No. 9 piano wire will answer, and the more *quickly* the loop can be closed the better. Before tightening the loop the parts should be inspected to see that the uvula is not included, which might occur if there is considerable oozing of blood. If there is any difficulty in keeping it out of the way it should be grasped by its tip with a small hemostat, which will effectually prevent its being included in the loop.

Open wounds of the pharynx heal more quickly if let alone; especially when retching, gagging and increased irritation result from medication of the wound. Frequently a superficial slough presents somewhat the appearance of a pseudomembrane; but is without significance as far as healing is concerned. However, cases of sepsis severe enough to endanger life, and thrombosis of the internal jugular extending upward into the cavernous sinus have been reported. The patient should **remain in bed** for a day or so, or until the temperature is normal, and subsist on a **soft diet** until the soreness of the parts subsides sufficiently to permit the swallowing of more solid food. If the wound is not doing well, it may be touched with a 12 per cent. solution of **silver nitrate**, or dusted by means of a powder-blower with a powder of equal parts by weight of **iodoform, tannic acid and bismuth**, which will closely adhere to the wound and re-

main in contact with it for a long time.

Occasionally operations on the tonsil are followed by dangerous hemorrhage. This generally occurs at the time of the operation or some hours after, when the patient is thoroughly recovered from the ether. Before operating the pharynx should be carefully inspected for anomalous arteries and the region of the tonsil palpated to detect any unusual pulsations. Resident physicians in hospitals should be trained in the methods of controlling hemorrhage after tonsil operations, and nurses should be instructed to **inspect** a child from time to time **after a tonsillectomy** to be assured that the child is not swallowing blood; for when hemorrhage occurs some hours after the operation in young children, the blood is usually swallowed; so that the first symptoms of danger may be the vomiting of a large quantity of blood, rapidly followed by collapse. Under such circumstances, a **tonsil clamp** may be useful in controlling the hemorrhage until more effective measures can be instituted. The clamp can be applied either alone or over a gauze sponge inserted into the tonsillar fossa. However, **no clamp** is as effective in controlling hemorrhage **as digital pressure through a gauze sponge** on the bleeding tissues. The pressure should be continued for a few moments, the sponge then gently removed and the parts inspected. It is possible that all parts of the wound will be found apparently oozing blood. Under such circumstances, the **sponge** should be **moistened with hydrogen dioxide**, inserted into the tonsillar fossa and pressure again applied; upon the removal of this sec-

ond sponge, the hemorrhage will be manifestly less, and probably will be controlled by painting the parts with **diluted Monsel's solution**. Possibly one or more points will still continue to bleed, and to these the undiluted Monsel's solution should be applied by means of a cotton-tipped applicator held firmly upon the bleeding point. Monsel's solution is an irritant, and the undiluted solution should be used with care that no excess of the solution trickles down the pharynx into the larynx. After the oozing of blood from one tonsil is controlled, the other should be treated in the same manner, and if blood is seen flowing from the adenoid wound behind the palate, dilute Monsel's solution should be painted upon this wound also, by means of a bent cotton-tipped applicator. Before applying Monsel's solution it might be well to see what can be accomplished with **coagulen, thromboplastin**, or one of the other biologic hemostatics which can be used hypodermically and locally, and are less irritating than Monsel's solution. If these measures fail to control the oozing, the **tonsillar fossa** should be **packed** with gauze and the anterior and posterior **pillars sewed together** over it.

If the removal of a tonsil is followed by profuse hemorrhage, this should be controlled by inserting one or more **sponges** into the **tonsillar fossa** and making firm **digital pressure**. After a few moments the sponges are cautiously withdrawn in such a manner that one part after another of the wound is exposed, so that any spurting artery can be seized by **long Kocher hemostats** and tied. If at the first attempt the vessel is not seized, a slight twist upon

the instrument will probably control the hemorrhage sufficiently to enable the operator to see the bleeding spot more distinctly and clamp it with a second pair of hemostats. Small spurting arteries give no especial trouble except that it is a little more awkward to tie them than in a superficial wound. Occasionally a vessel upon the inner surface of the anterior pillar will bleed in such a manner as to momentarily confuse the operator; because when the pillar is drawn forward the pressure will be sufficient to control the hemorrhage, which occurs immediately the pillar is released. However, if the pillar is everted with a Goddard pillar retractor or some similar instrument so that its cut posterior surface can be inspected, the **bleeding vessel** is easily found and tied.

Occasionally, after the removal of adenoids and tonsils, patients recover from their ether very unsatisfactorily and for a long time remain nearly pulseless, with shallow respiration. The extremities are cold, and the little patient, although conscious, is aroused with difficulty to answer questions. Such symptoms occur sometimes in children who are fairly robust and who have not received an inordinate amount of ether nor lost a large amount of blood at the operation. Fatal cases of this character have been attributed to the presence of a thymus gland that has not undergone spontaneous metamorphosis and partial absorption, the so-called "habitus lymphaticus." It is probable that in some of the fatal cases reported, the element of surgical shock must have played an important rôle; and that it is always safest to subject the tissues of the pharynx to

as little rough handling as possible during tonsillectomies, and as little blunt dissection as is compatible with safety from hemorrhage. If during the operation the use of the tongue depressor causes the patient's respiration to cease, pressure should be relaxed until the respirations become normal. If necessary, the tongue should be drawn out of the mouth with volsellum forceps and pressure applied to only that portion of its base necessary to display the tonsil. In some cases embarrassed respiration becomes very much improved after the removal of the first tonsil. No more ether should be used than is necessary to produce relaxation of the pharyngeal muscles, and it should be remembered that the pharyngeal reflex is one of the last to disappear under ether. There should be no more hemorrhage than is unavoidable, and the surgeon or his assistant should take the time and pains to stop practically all the bleeding after one tonsil is removed, before removing the other. Lowering the head more than is just sufficient to prevent blood gravitating into the larynx, or lowering the head by bending the head backward, so greatly increases the congestion of the pharynx that what is gained by decreased probability of blood reaching the larynx is lost by increased congestion. Consequently there is commonly less hemorrhage with the patient lying on one side, so that blood gravitates into the hollow of the cheek, than when the patient is prone, there being less necessity for greatly lowering the head.

If, in spite of precautions, the little patient is profoundly shocked by the operation, the foot of the bed should be raised and oxygen administered.

The heart's action should be maintained by heat over the heart and strychnine, and blood-pressure increased by the use of 8 ounces (250 c.c.) of normal salt solution by hypodermoclysis and the institution of enteroclysis by the drop method.

Sepsis severe enough to threaten life, deep cervical cellulitis resulting in abscess, and thrombosis of the internal jugular extending through the lateral sinus into the cavernous with resulting loss of vision in one or both eyes have been reported. Considering the fact that the mouths of children on whom tonsillotomies are done often contain carious teeth, it is astonishing that such wounds do not oftener become infected. However, it is noticeable that infection most often occurs at the hands of those who are most careful of the after treatment of tonsillectomy wounds, and it is possible that the gagging, retching and consequent irritation of the wound may invite infection. The author merely inspects the wound for the first three days.

X-ray treatment of the tonsils is mainly indicated in patients who are bad operative risks or will not consent to tonsillectomy, and in the hysterical, neurotic, or senile. The reduction in size of hypertrophied tonsils is about 50 per cent. Even after treatment, purulent and cheesy material could be expressed from the crypts. Shurly (Jour. Amer. Med. Assoc., Sept. 8, 1923).

Twelve cases treated by radium implantation in the form of Muir's removable platinum-radon seeds. Only one treatment is required. The seeds remain in position 4 days, then are pulled out by a protruding thread. No anesthetic is required at any time. The tonsils then undergo atrophy. J. C. Scal (Med. Jour. and Rec., Dec. 1, 1926).

The *lingual tonsil* is subject to the same diseases that affect other adenoid structures of the pharynx. Occasionally a venous varix occurs at the base of the tongue on and about the lingual tonsil. If its size is a source of irritation the principal veins should be destroyed with the **galvanocautery**, which, for this purpose, should not be above a dull-red heat, or the vein will be opened and hemorrhage occur. The lingual tonsil becomes sufficiently hypertrophied sometimes to cause irritation and reflex cough. Under such circumstances the **redundant tissue** should be **cut away** by suitably curved scissors with serrated edges to prevent the flabby tissue slipping from the blades, by **Myles's lingual tonsillotome**, or by removing the elevations one after another with a **snare**. However, the application of 20 per cent. **silver nitrate** gives relief from reflex cough, and in mild cases is curative. Occasionally a supernumerary thyroid gland or "lingual goiter" is found at the base of the tongue; it should not be mistaken for hypertrophied lingual tonsils.

ACUTE PHARYNGITIS.

Acute pharyngitis is an acute inflammation of the pharyngeal mucous membrane and underlying structures.

SYMPTOMS.—The constitutional symptoms are usually trifling: A feeling of lassitude with slight fever; the throat feels sore, dry and stiff. These symptoms increase until the pain, especially when deglutition is attempted, is quite severe. The cervical glands are often swelled and painful to the touch. The voice is generally husky, and a sensation, as if a foreign body in the throat, forces the patient to hawk and expectorate.

ETIOLOGY AND PATHOLOGY.—Acute pharyngitis is generally the result of exposure to wet and cold, especially in persons suffering from a rheumatic diathesis or from general debility. It may also be caused by traumatism or the presence of a foreign body in the pharynx.

The inflammation is not evenly distributed over the pharyngeal mucous membrane, the glandular elements always being most affected. Their secretion is at first increased, but after a time decreased, becoming starchy and glue-like in character. The tonsils are always involved, the inflammation of these organs being sufficiently marked sometimes as to cause them to mask the inflammation of adjacent structures.

TREATMENT.—A **saline cathartic** should be administered in sufficient quantity to secure one or more free movements of the bowels. A 10 per cent. solution of **nitrate of silver** should be painted over the inflamed lateral walls of the pharynx once or twice a day. Care should be exercised not to touch the posterior wall, or the patient's suffering will be increased rather than diminished. On the posterior wall 10 to 20 per cent. **argyrol** gives better results than silver nitrate. It should be borne in mind that, while the application of a weak solution of nitrate of silver to the inflamed fauces is painful and acts as an irritant, the application of 10 to 20 per cent. solutions is not painful, and is immediately followed by a sensation of relief and comfort, and tends to materially shorten the course of the disease. The application of the silver solution should be followed by spraying the parts with an 8 per cent. solution of **antipyrin**. A

demulcent gargle or **lozenge** should also be prescribed for the patient's use. When acute pharyngitis is due to the presence of a **foreign body**, it should, of course, be at once **removed**, and the inflamed pharynx treated as acute pharyngitis. When the rheumatic diathesis exists, the administration of **guaiac**, either alone or combined with **potassium iodide**, will be found to yield most excellent results, while in gouty sore throat **colchicum** should be prescribed. A spray of **alumnol**, 1 dram (4 Gm.) to 4 fluidounces (125 c.c.) of water used every hour relieves the congestion. When it is inconvenient for the patient to use an atomizer, lozenges may be prescribed. Among the most popular are **chlorate of potash** and **tannin**, **camphor**, **menthol**, and **guaiac** combined with **iodide of potash** or **tannin**.

SIMPLE CHRONIC PHARYNGITIS.

Simple chronic pharyngitis is a chronic inflammation of the mucous membrane of the pharynx generally the result of chronic rhinitis. The disease is often complicated by inflammation of the follicles of the mucous membrane, and is then called "follicular pharyngitis."

TREATMENT.—It is all important to bring about a cure of the nasal disease to the presence of which the pharyngeal malady is due. After the **primary nasal affection** has been **relieved**, simple chronic pharyngitis will often get well almost without treatment. During the treatment of the nasal affection, however, applications should be made to the vault of the pharynx of 8 per cent. **glycerole of tannin**, 1 or 2 per cent. **chloride of zinc**, or a solution containing:

R *Iodine* gr. v (0.3 Gm.).
Potassium iodide .. gr. xv (1 Gm.).
Glycerin f5j (30 c.c.).

A tongue depressor should be used to hold the tongue down, and the patient be requested to try to breathe through his nose in order to relax the palatine muscles. The application may then be made without difficulty by means of an applicator, the end of which has been wrapped with cotton and bent to a suitable curve. Should, however, the palate lie closely in contact with the pharyngeal wall, considerable force will be required to carry the end of the applicator into the postnasal space, while most of the solution with which the cotton on the end of the applicator has been saturated will be squeezed out and remain in the fauces. Applications made in such a manner irritate the parts mechanically and tend to increase the existing inflammation rather than to subdue it; and it is always best to desist from making an application to the pharyngeal vault under such circumstances.

CHRONIC FOLLICULAR PHARYNGITIS.

Chronic follicular pharyngitis, or clergyman's sore throat, is a chronic pharyngitis characterized by inflamed and hypertrophied lymph-follicles.

SYMPTOMS.—The secretions are usually somewhat scanty and viscid, and voided with considerable difficulty. There is a short, frequent cough, distressing alike to patient and friends; the so-called "useless cough," because it accomplishes nothing, either in ridding the throat of secretions or the constant pharyngeal irritation, of which many of these patients complain.

The appearance of the pharynx

swallow, with hypodermics of **strychnine** ($\frac{1}{30}$ grain—0.0002 Gm.) every three or four hours to prevent collapse.

LUDWIG'S ANGINA.

This was first described by Ludwig, in 1836, as a severe infection, beginning in the submaxillary region, where it soon assumes a character which he termed "gangrenous inflammation of the neck."

SYMPTOMS.—The disease begins as a hard, painful swelling in the submaxillary region, which may run a mild course for days and then suddenly assume an alarming character, because the swelling of the parts interferes with respiration and the swallowing of nourishment. The temperature and pulse are very often comparatively low, but dyspnea may require **tracheotomy** within twenty-four hours of the onset of the disease. In most cases septic intoxication is of less moment as a cause of death than the involvement of the respiratory tract, and death may occur even after tracheotomy from syncope or dyspnea in spite of **artificial respiration** and **oxygen**.

ETIOLOGY.—The etiology of Ludwig's angina so clearly resembles that of phlegmonous pharyngitis that Semon and others have maintained that the diseases were practically identical. There is usually a mixed infection of streptococcus with staphylococci or diplococci.

PATHOLOGY.—The disease is essentially a rapidly spreading cellulitis, beginning in the region of the submaxillary gland from a point of infection, usually a carious tooth, tonsillitis, or an ulcer in the mouth. Fatal results occur from invasion of the larynx, trachea, and the lungs

with general systemic infection. Any rapidly spreading cellulitis of the floor of the mouth is a menace to life because the anatomical conditions favor the early involvement of the larynx, and because of the compression of the inflammatory material within the jaw and under the tongue.

TREATMENT.—Early cases are best treated by the application of **tincture of iodine** to the inside of the lower jaw and adjacent buccal floor every three hours. Early **incision** parallel to the lower border of the jaw over the submaxillary triangle should be done in the expectation of laying bare the focus of infection, which is reached with more certainty in most cases by the safer median incision beneath the chin above the hyoid bone. Incisions on the floor of the mouth are rarely successful in liberating pus.

When an abscess or pus is not found in the submaxillary incision the mylohyoid muscle should be divided and the sublingual cellular tissue exposed. Early incision will probably prevent the irregular septic temperature; profuse sweating and delirium are recorded in some cases. However, after the sublingual tissue has been exposed, should the symptoms indicate, hourly injections of **antistreptococcus serum** with **normal salt solution** by the rectum and stimulants should be given, as in the treatment of phlegmonous pharyngitis.

VINCENT'S ANGINA.

This is an infection of the pharyngeal mucous membrane by characteristic fusiform bacilli and spirochætæ, which are different stages of the same micro-organism.

The disease may be associated with

diphtheria, syphilis, or streptococcus or staphylococcus infection.

SYMPTOMS.—The symptoms are usually those of subacute pharyngitis, unless mixed infection is present. Headache and general malaise, with a temperature up to 102.5° F. (39.2° C.), may be present. The breath is foul, the throat painful when swallowing, and there is generally some swelling of the submaxillary glands.

The frequent occurrence in the tonsillar crypts of actinomyces-like granules containing the typical fusiform bacilli and Vincent's spirochetes, together with streptococci and ray-like segmented filaments, has been noted by the writers. The 3 chief habitats of Vincent's organisms are the tonsillar crypts; the teeth, especially tartar deposits; and the smegma in the preputial sac and about the clitoris. In the mouth and tonsils, streptococci always coexist, and in the smegma, staphylococci. The lesions induced when virulence is heightened or resistance poor comprise not only Vincent's angina, but also ulceromembranous stomatitis, noma, putrid otitis media, putrid bronchitis, gangrenous pneumonia, occasionally gangrenous appendicitis, and gangrenous processes about the genitals. The more frequent taking of smears from the throat would reduce the frequency of confusion of this form of infection with diphtheria and syphilitic ulcers. In 96 of Anthon's 98 cases, marginal gingivitis preceded or accompanied the throat condition, and in 85 cases but 1 side of the throat was affected. D. J. Davis and Pilot (Jour. Amer. Med. Assoc., Sept. 16, 1922).

DIAGNOSIS.—The disease differs from an ordinary acute pharyngitis due to streptococcus or staphylococcus infection in the usually less severe constitutional symptoms, the great tendency to ulcerations, and the presence of characteristic organisms. However, Vincent states that in the

diphtheroid form of the disease there is simply a membranous inflammation without ulceration and that only fusiform bacilli can be isolated.

The incubation period of this disorder, also known as *trench mouth*, is 6 days. The causative organisms stain fairly well with methylene blue or aniline gentian violet, but best with carbol-fuchsin. The **teeth** should be **cared for** as required and a gargle of 50 per cent. **hydrogen peroxide** used every ½ hour. The ulcer is cleaned with peroxide and treated with a **zinc iodide** solution. G. O. Doane (Jour. Iowa State Med. Soc., Nov., 1924).

PROGNOSIS.—The prognosis, where no mixed infection is present, is good, the symptoms abating in three or four days, although some redness of the pharyngeal mucous membrane may persist for many days. In cases of mixed infection the severity of the symptoms depends upon the character of the mixed infection.

TREATMENT.—When ulcerations are present, with sloughing pseudomembrane, the parts should be first thoroughly cleansed, and then 5 per cent. **arsphenamin in glycerin** thoroughly applied, especial attention being directed to the floor of the ulcerations. The ulcers are then covered with an antiseptic powder. Either **orthoform** or a mixture of **iodoform**, 3 parts; **tannic acid**, 2 parts, and **bismuth subnitrate**, 6 parts, may be used. The spirilla are very sensitive to arsenic, and either **arsphenamin** or **neoarsphenamin** may be injected as in the treatment of syphilis. The local treatment is, however, usually sufficient, and as the organic arsenicals are expensive, **Fowler's solution** may be substituted. Daily applications of 12 per cent. **silver nitrate** solution also give good results, and

may be followed by applications of a 1 per cent. solution of **methylen blue**. In mild cases in which there are neither ulcerations nor extensive pseudomembranes, applications of 2 to 4 per cent. **silver nitrate** solution suffice, the patient in the meantime spraying the throat two or three times a day with $\frac{1}{2}$ to 1 per cent. **copper sulphate** solution.

The writer uses a saturated solution of **chromic acid**, applied with cotton tightly wound on a small wooden stick, the cotton being merely moistened with the acid. The patient then **gargles** at once with water, and thereafter gargles several times a day with **hydrogen peroxide** solution diluted 1:10 or with 1 per cent. **resorcinol** solution. Dubreuilh (*Jour. de méd. de Bordeaux*, Mar. 25, 1920).

The author successfully used a 10 per cent. **copper sulphate** solution. C. R. King (*Laryngosc.*, Dec., 1921).

Five per cent. **chromic acid** solution employed. In stomatitis, several daily applications may be necessary. Anthou (*Zeit. f. Hals-, u. Ohr.*, Mar. 22, 1922).

The writers applied with success to the ulcer an aqueous solution of **iodine**, such as Churchill's, followed at once, over the wet iodine, by 20 per cent. **silver nitrate** solution. This may be repeated at 2-day intervals. Fresh **sodium perborate**, 1 teaspoonful in $\frac{1}{2}$ glass of hot water, is to be used as a mouth-wash at $\frac{1}{2}$ hour intervals or less often, according to the severity of the attack. Stillman and McCall (*N. Y. Med. Jour.*, Aug. 1, 1923).

A specific effect in Vincent's angina is exerted by the intravenous injection of 5 c.c. (80 minims) of a 1 per cent. solution of **tartar emetic**. T. L. Driscoll (*Va. Med. Mthly*, July, 1924).

LEPROUS PHARYNGITIS.

According to Hollmann, leprosy of the pharynx begins by the formation of small tubercles, which break down, forming ulcerations which finally

penetrate the soft palate, so that in some instances the perforations are so numerous that the palate resembles a sieve. Similar ulcerations occur on the pharyngeal wall and the tonsils. In some cases a small ulcer may assume a gangrenous character, associated with marked systemic toxemia. Under these circumstances, treatment consists in the injection here and there into the gangrenous ulceration of a few drops of a 5 per cent. solution of **zinc chloride**; this in a day or two causes a slough which, when detached, exposes clean, healthy tissue.

The tonsils frequently are the seat of leprous tubercles and become greatly hypertrophied, with subsequent fibroid changes.

TUBERCULOSIS.

The presence of the tubercle bacilli is sometimes demonstrable, by means of the microscope, in the secretions of a mild chronic pharyngitis of nurses and attendants in the tuberculosis wards of hospitals. Primary tuberculous pharyngitis with marked lesions is rare. Secondary tuberculous pharyngitis in phthisic patients is somewhat common, and is usually observed as ulcerations resembling those of tertiary syphilis.

Infection probably reaches the pharynx through some localized solution of continuity from the secretion of the tuberculous lungs. Tubercles form in the submucosa, and finally break down and ulcerate.

TREATMENT.—In cases where there are no marked lung lesions and the diagnosis is obscure, the Wassermann reaction should be carried out or the antisyphilitic remedies given until the surgeon has satisfied himself that the disease is not syphilis.

When ulceration has occurred the ulcers should be cleansed with **hydrogen dioxide, cocainized**, and touched with **lactic acid** once in two or three days. As these applications are somewhat painful, even after cocainization, it is well not to employ a stronger solution than 25 per cent. until the amount of pain and reaction caused by the application has been ascertained, after which the concentrated syrupy acid may be employed if deemed advisable. Rarely is it necessary to employ the **curette**, and the prognosis as regards healing is favorable.

LUPUS VULGARIS.

This is a form of inflammation involving the mucous membrane and submucous tissues of the pharynx, generally ending in ulceration due to the presence of the tubercle bacilli.

SYMPTOMS.—The general condition of the patient may be that of good health. The disease is insidious and causes little annoyance until the ulcers are sufficiently large to interfere with the functions of the parts. Early in the disease soft, reddish nodules about the size of sago grains appear on one or both sides of the pharynx. These finally break down, producing ulcers which may spread to the pillars of the fauces, the palate, or the larynx, one portion of the ulceration healing while another is extending.

DIAGNOSIS.—The ulcerative stage may be mistaken for herpes, syphilis, or epithelioma. The short duration of herpes and the more rapid progress of epithelioma should serve to differentiate the diseases from lupus. In suspected syphilis the Wassermann reaction or the "therapeutic test" with iodide of potassium

serves to clear up the diagnosis. The tuberculin test gives a positive reaction, causing local hyperemia and some rise of temperature, which subsides in twenty-four hours. The microscope shows typical tubercle giant cells.

ETIOLOGY.—The disease is said to be more common on the continent of Europe than in America. It occurs in tuberculous families and in those frequently brought in contact with tuberculous patients.

PATHOLOGY.—Portions of the diseased tissue curetted away show, under the microscope, typical giant cells. However, tubercle bacilli are found only in small numbers and with difficulty.

TREATMENT.—The parts should be thoroughly **curetted** and the **solid stick of nitrate of silver** applied. Cures have been reported by the use of the **X-ray**.

ACTINOMYCOSIS.

This is a parasitic, infectious, inoculable disease, first observed in cattle and later in man. It is due to the presence of the leptothrix streptothrix, or ray-fungus. The most frequent and curable form of the disease is when abscesses form about the jaws or fauces. When the parasite has found a nidus in the lungs or digestive tract the disease generally proves fatal.

SYMPTOMS.—The symptoms and pathology of the disease, as affecting the human tonsils, were first described by Jonathan Wright (1904). The symptoms are those of granulating, painless abscess with general systemic infection. The laryngologist is usually first consulted by the patient for catarrh and hypertrophied tonsils. One or more crypts of the

tonsils may be suppurating and lined with granulations.

ETIOLOGY.—Actinomycosis is the result of inoculation with the ray-fungus, which gains entrance to the mouth, pharynx, or nose from ingesta or inspired air. The disease may originate primarily in either of these cavities and, more rarely, in the larynx or ear.

PATHOLOGY.—A slow swelling occurs, usually first at the angle of the jaw, which renders swallowing difficult. Upon inspection, if supuration has not already occurred, the mass will be found to be firm to the touch and involve one or more of the cervical glands or the tonsils. At the seat of infection a nodule occurs which breaks down and discharges pus containing typical granular masses, which, upon compression, form star-like bodies, yellowish in color, with a center which stains blue with Mallory's stain.

TREATMENT.—The affected tonsil or tonsils should be **amputated**. Where this cannot be done, the application of the **galvanocautery** is the best form of treatment. Each **nodule** or **suppurating crypt** should be thoroughly **destroyed**. **Abscesses** occurring in localities other than the tonsils should be **opened, curetted, and cauterized** with the **solid stick of nitrate of silver**. **Iodide of potassium** in large doses is stated to inhibit the growth of the ray-fungus, and Sawyer reports favorable results from the injection into tumors of from 15 to 30 minims (0.9 to 1.8 c.c.) of a 1 per cent. solution of the **iodide**.

RETROPHARYNGEAL ABSCESS.

An abscess of the posterior pharyngeal wall may be hidden above and

behind the soft palate, and **require** the rhinoscope to ascertain its outline; it may be situated opposite the larynx and only be partly visible with the laryngoscope; or it may be situated in such a manner as to be hidden by one of the posterior pillars of the pharynx. However, the most common seat of abscesses is the posterior wall of the pharynx opposite the oral cavity.

It may follow: (1) Most commonly, infection of the retropharyngeal lymph-nodes, which receive lymphatics from the nasal fossæ and sinuses, Eustachian tubes, and nasopharynx; (2) otitis media; (3) necrosis, usually tuberculous, of the upper cervical vertebræ; (4) carotid abscess.

There is usually but slight systemic disturbance. Local symptoms are usually the first to attract attention, especially in infants, among whom the disease is more common. When the abscess is situated high up upon the pharyngeal wall, a sensation suggesting the presence of a foreign body causes almost constant hawking and spitting, while there may be present obstructed nasal respiration with more or less pain and tinnitus. When the abscess is opposite the larynx, dyspnea is a marked symptom, appearing in "spasms," which may endanger the patient's life, while swallowing of liquids or solids is dangerous, owing to their passage into the larynx. An abscess in the pharyngeal wall opposite the oral cavity presents none of these symptoms unless it is very large.

PROGNOSIS.—The prognosis is favorable except in those cases where the spinal vertebræ are involved. In all operations upon the posterior wall of the pharynx it should be borne in

mind that a large artery is occasionally found in this position, probably the vertebral, which sometimes enters its osseofibrous canal as high up as the fourth or even second vertebra. It has been seen to leave its canal at the third vertebra, to re-enter it at the atlas.

TREATMENT.—Left to itself, a retropharyngeal abscess will discharge either into the throat or at some remote point, but it should be opened as soon as a diagnosis is made, by means of a curved small trocar and cannula. Should the pus recur, an incision should be made into the abscess at its lowest part, and the opening maintained patulous by the daily passage of a probe.

The author has several times opened a retropharyngeal abscess without general anesthesia, with the child in an upright position. However, it is probably better to place the patient on his side, with the foot of the operating table elevated as for a tonsillectomy. The abscess is then located with the forefinger-tip, which serves as a guide for a long-handled knife, and the abscess incised, washed out with boric acid solution, and iodoform emulsion in glycerin injected. When the abscess is complicated by caries of the vertebræ it is better opened through the skin by the external route. An incision two or three inches long is made on a plane with the abscess, parallel to the anterior border of the sternocleidomastoid muscle. The deep cervical fascia is opened and the anterior border of the sternocleidomastoid muscle exposed and drawn forward. By blunt dissection the carotid sheath, with its vessels and nerves, is separated from the vertebræ and drawn

forward and the dissection carried in front of the vertebræ to the abscess wall, which is punctured and a closed hemostat inserted and withdrawn opened. The cavity is then explored by the finger for necrosed bone and a drainage-tube inserted. Aneurism has been mistaken for retropharyngeal abscess with fatal results following incision, so that it is important to arrive at a correct diagnosis before operating.

FOREIGN BODIES IN THE PHARYNX.

This subject has been in part reviewed in the article on the ESOPHAGUS (volume v), the majority of foreign bodies which enter the pharynx being, in reality, impacted in the upper portion of the former, either behind the larynx or on either side of the latter, in one of the pyriform sinuses, or above the epiglottis. When, therefore, foreign bodies of the pharynx are spoken of and the limits of this cavity are properly established, the scope of the subject becomes restricted. Indeed, unless it be a sharp object capable of sufficiently lacerating the upright posterior pharyngeal wall to hold on to it, a foreign body will either pass below to the esophagus as stated, or into the larynx, or lodge behind one of the pillars or into the tonsils. Strictly speaking, the latter are the seat of almost all foreign bodies which can be said to have become impacted in the pharynx. These are almost always sharp objects,—fishbones, tacks, pins, etc.,—capable of easily penetrating the tonsillar crypts or between the pillars, or in the recess behind the posterior pillar.

Foreign bodies are often referred to as still present in the pharynx

when, in reality, they have passed downward. This is usually due to the presence of a minute abrasion or scratch produced by the foreign body on its way downward. Again, hysterical subjects seem to present a predilection for pharyngeal foreign bodies, and in the majority of cases of this kind a foreign body has not been swallowed at all.

SENSORY PHARYNGEAL NEUROSES.

ANESTHESIA occurs as a symptom of various disorders in which the general nutrition is impaired, especially anemia and phthisis, and of cerebral disorders: apoplexy, general paralysis, tumors, etc. Some drugs—the bromides—induce sufficient anesthesia of the pharynx to facilitate local operations in this region. Certain neuroses—epilepsy, hysteria, and chorea—are also attended by more or less pharyngeal anesthesia.

HYPERESTHESIA.—Hyperesthesia is usually observed in individuals whose pharynges are kept in a congested state through unhygienic habits, local disease, etc. Thus, drunkards almost invariably have very sensitive pharynges, while tonsillitis and pharyngitis, and certain gastric and hepatic disorders tend to cause hyperesthesia through engorgement of the vascular system, etc. Pharyngitis sicca is frequently attended by marked hyperesthesia.

PARESTHESIA.—Abnormal sensations in the pharynx, heat, cold, the presence of a foreign body, enlargement, "tickling," and particularly the painful sensation that a scratch produces are commonly observed. While occasionally these subjective symptoms represent but

hallucinations of sensation, a cause can usually be detected when a sufficiently careful search is instituted. A sensation suggesting the presence of a foreign body, for instance, is frequently due to an almost imperceptible laceration or abrasion of the mucous membrane caused by a spicule of bone, a small piece of crust, a seed, etc. Inflammatory tonsillar disorders of almost any kind may also act as etiological factors; the lingual tonsils or mass of lymphoid tissue at the base of the tongue when enlarged being especially active in this particular. Among the general diseases capable of acting as sources of this disorder are the menopause, the rheumatic and gouty diatheses, hysteria, and neurasthenia; among the local causes, elongation of the uvula, nasopharyngeal catarrh, and pharyngitis sicca.

TREATMENT.—In all these manifestations the cause should be sought after and corrected and the pharyngeal surfaces treated according to the character of the lesion noted.

PARALYSIS OF THE PHARYNX.

ETIOLOGY.—Paralysis of the pharynx is usually caused by diphtheria, syphilis, or cerebral affections implicating the nerves which supply the pharynx. It is sometimes caused by local inflammation, especially when this is membranous. The paralysis may be limited to one constrictor muscle, or involve them all; it is an occasional complication of hemiplegia. It frequently occurs as a precursor of death in febrile diseases, especially typhus and pneumonia.

SYMPTOMS.—Besides nasal speech there is difficulty of deglutition, great effort being required to

force the food down the esophagus. Liquids are generally swallowed with less difficulty, but their frequent passage into the larynx renders their use dangerous. When the soft palate is involved, the food may be forced into the posterior nasal cavity, through the efforts of the tongue to assist deglutition. The accumulation of mucus on the pharyngeal wall is very troublesome.

TREATMENT.—Besides **treatment of the central cause**, **strychnine** hypodermically and general **tonics** are almost always indicated. **Arsenic** is especially valuable when the affection is a sequel to diphtheria. **Electricity** serves the double purpose of assisting in the diagnosis and restoring motion. When the paralysis is of central origin, an interrupted current will cause contraction of the muscles, but this contraction will not occur if atrophy of the muscles is the principal pathological element of the case; the cure will then be rendered much more difficult, if at all possible. Therapeutically, electricity should be applied with both electrodes over the muscles for about ten minutes every other day.

TUMORS.

Any of the varieties of tumor found in other parts of the body may occur in the pharynx. They are most frequently¹¹ located in the lateral walls and may involve the surrounding structures. In the following order of frequency are found in the pharynx:¹² Gumma, sarcoma, carcinoma, lupus, papilloma, cysts, fibroma, osteoma, enchondroma, adenoma, and aneurisms.

When the growth is large it may become an obstruction to deglutition or even respiration. In carcinoma

and ulcerating growths, pain is present, usually radiating into the ear.

TREATMENT.—Early **extirpation** with the **knife**, **galvanocautery**, or **snare** should be practised in suitable cases.

DISEASES OF THE UVULA.

INFLAMMATION OF THE UVULA may occur primarily or as the result of extension of inflammation from the tonsils or palate.

Occasionally the uvula becomes edematous and distended. The distention may be so great as to produce dyspnea. The treatment consists in **cocainizing** the **uvula**, seizing it with a pair of mouse-tooth forceps, and freely **incising** the **mucous membrane** in a number of places in order to allow the fluid to escape. The same object may be accomplished sometimes more conveniently by **snipping off** the **mucous membrane at the tip of the uvula**.

Pseudomembranous Uvulitis.—The extension of a pseudomembrane from the tonsils to the uvula is somewhat characteristic of diphtheria. However, this occurs in other forms of pseudomembranous pharyngitis.

Treatment of Inflammation of the Uvula.—As inflammation of the uvula generally is only a part of an inflammation involving the rest of the fauces, it is best to begin treatment by spraying the fauces with a 1:10,000 solution of **adrenalin**; the uvula should then be painted with a 10 per cent. solution of **nitrate of silver**. This should be done in the physician's office once or twice a day, the patient in the intervals either spraying his fauces every two or three hours with a 1:10,000 solution of **adrenalin** or a 3 per cent. solution of **alumnol**.

ULCERATION OF THE UVULA.—The uvula sometimes becomes ulcerated as the result of traumatism and infection. Syphilis, lupus, or tuberculosis may be primarily located in the uvula. The uvula is sometimes destroyed by an ulcerating gumma. Occasionally these cases are first seen by the laryngologist when the ulcer has made considerable progress and the uvula hangs, as it were, by a shred of mucous membrane.

Under these circumstances the uvula sometimes can be saved by the application of vigorous **antisyphilitic treatment**.

Where an ulcerating gumma involves the posterior wall of the pharynx as well as the uvula and soft palate, there is great danger of the occurrence of cicatricial adhesions that may entirely shut off communication between the posterior nares and the oropharynx.

DEFORMITIES OF THE UVULA.—**Bifid Uvula.**—The uvula when present is always bifid in cleft palate as the result of the same cause that produces the palate deformity. Hence, ordinary bifid uvula might be considered as an incomplete cleft palate. The deformity varies from a little dent at the free extremity of the uvula, which is usually club shaped, to a complete division separating the uvula into two lateral halves.

Treatment.—Bifid uvula, when it causes no symptoms, is best let alone. However, the parts may be **freshened** by means of a **V-shaped incision and sewed together**. If the uvula is thoroughly **cocainized** and then sprayed with **adrenalin**, the operation is both painless and blood-

less. For anesthetizing the uvula, simply painting the parts with a 10 per cent. solution of **cocaine** is not sufficient. The operator should be provided with a small cup at the end of a long handle. This is partly filled with a 4 per cent. solution of cocaine, and held under the palate in such a manner that the uvula soaks in the cocaine solution for a few moments before the operation.

ELONGATION OF THE UVULA.—The whole mass of the uvula may be hypertrophied. More frequently, however, merely the mucous membrane is relaxed and hangs as a conical tip below the uvula proper. In rare cases a warty growth is attached to the end of the elongated uvula.

Symptoms.—Patients complain of a "tickling in their throats." The elongated uvula hanging in contact with the base of the tongue causes an almost constant short cough as an effort to dislodge a supposed foreign substance. These efforts are sometimes persisted in until nausea and vomiting result. Snoring is usually marked and the sleep is disturbed by dreams.

Etiology.—It is generally the result of chronic pharyngitis, the constant hawking to dislodge masses of mucus from the pharynx having a tendency to cause the affection. Paralysis of the palate is a reflex sometimes observed in ethmoiditis, and in such cases paralysis of the azygos uvulæ muscles and consequent elongation of the uvula are concomitant with the affection.

Treatment.—The redundant portion of the uvula should be amputated. This is ordinarily only relaxed and redundant mucous membrane at

the tip of the uvula. It is rarely or never necessary to remove any of the muscular structure of the organ, and amputation of the entire uvula close up to the soft palate is done only for the removal of malignant disease, or as the result of ignorance or awkwardness of the operator. The operation is perhaps best done in the following manner: The uvula is grasped, at a point just below where it is decided to amputate, with a pair of long hemostats, which are then clamped. The position of the hemostat marks the spot on the uvula where it has been decided to amputate, so that there is no danger of cutting off too much or too little. The uvula is stretched well forward and cut off close to the forceps by a single cut of a pair of somewhat heavy scissors, curved upon the flat, and held with their concavity upward in such a manner that the uvula is cut somewhat obliquely upward; and the wound, being upon the posterior surface, is protected from contact with food during the healing process. Generally there is but little inflammatory reaction and the wound heals promptly, but occasionally a mild acute pharyngitis occurs as the result of the operation when the uvula is thick and fleshy.

E. B. GLEASON,
Philadelphia.

PHENOBARBITAL.—This compound, also known as **luminal**, is chemically phenylethylbarbituric acid $[\text{CO}(\text{NH} \cdot \text{CO})_2\text{C}(\text{C}_2\text{H}_5)(\text{C}_6\text{H}_5)]$, and differs from barbital (diethylbarbituric acid) only in that one ethyl group of the latter is replaced by one phenyl group. It is one of the hypnotic urea derivatives or ureids. It occurs in the form of small, white, glistening crystals or as a white, crystalline powder. It is odorless and slightly bitter in taste. It is almost insoluble in cold water (about 1:1000), slightly soluble in hot water. One Gm. of

it dissolves in about 8 c.c. of alcohol, 13 c.c. of ether, and 40 c.c. of chloroform.

PREPARATIONS AND DOSE.—

Phenobarbitalum, U. S. P. (phenobarbital). Dose, $\frac{1}{4}$ to 3 grains (0.015 to 0.2 Gm.); official dose, $\frac{1}{2}$ grain (0.03 Gm.).

Phenobarbital-sodium (luminal-sodium), unofficial, is chemically the monosodium salt of phenobarbital, or sodium phenylethylbarbiturate. It occurs as a white, crystalline, hygroscopic powder, readily soluble in water. It is less suitable for oral use than phenobarbital, having a more unpleasant taste, but where there is gastric intolerance or inability to swallow, may be given hypodermically in a fresh 20 per cent. solution in boiled and cooled distilled water, in doses somewhat larger than phenobarbital.

An unofficial elixir of phenobarbital, containing $\frac{1}{4}$ grain (0.015 Gm.) of the drug to the teaspoonful, is sometimes used.

PHYSIOLOGICAL ACTION.—Phenobarbital in moderate doses is an hypnotic. Its effects are in many ways similar to those of barbital, but it is generally conceded to be a more powerful and somewhat less safe drug, and is asserted to be a stronger circulatory depressant than barbital. In toxic doses it has a depressant action on respiration, and produces death by respiratory paralysis. It is possibly eliminated by the kidneys, although some have denied its presence in the urine. It exhibits the same tendency to cumulation as barbital, which renders it advisable to intermit the drug for two days in each week where it is used steadily, as in epilepsy.

POISONING BY PHENOBARBITAL.

—Single doses of 5 to 10 grains (0.3 to 0.6 Gm.) produce such effects as prolonged drowsiness, dizziness, headache, nausea, vomiting, and visual disturbance. Larger toxic amounts are likely to induce symptoms similar to those of acute barbital poisoning, with profound sleep or coma for one to three days, small pulse, more or less cyanosis, cool and moist skin, shallow respiration, dilated and non-responsive pupils, nystagmus, albuminuria, markedly diminished reflexes, and upon awakening, mental confusion. The toxic effects that may follow continuous use of an excess of the drug, as in epilepsy, include severe skin eruptions, sore throat, fever, gastrointestinal disturbances, and nephritis. Pheno-

barbital should be used with caution in pronounced lung or heart disease and in general debility, and is considered contraindicated in nephritis.

The treatment of poisoning is similar to that of poisoning by veronal (*q.v.*).

Case of poisoning in a male epileptic who was brought to the hospital unconscious 14 hours after taking 3 Gm. (45 grains) of luminal, with the symptoms of severe alcohol poisoning, including pallor, slight cyanosis, and relaxed muscular tone. The skin was cool and moist, and the reflexes markedly diminished. There were occasional athetotic movements, stertorous superficial respiration, pulse small and at times accelerated, and nystagmus. The pupils were moderately dilated and did not react to light. Gastric lavage was unsuccessful. The urine contained albumin. No luminal was demonstrable. The treatment consisted of **heat, caffeine and camphor**. The patient awoke a few hours later, confused. A lethargic condition persisted for 3 days. H. W. Nicolai (Klin. Woch., Oct. 8, 1923).

Case of fatal poisoning by 1 Gm. (15 grains) of luminal in an arteriosclerotic woman. Death in 29 hours. Weig (Deut. m. Woch., Feb. 13, 1925).

THERAPEUTICS.—Phenobarbital is employed, among other conditions, in **nervous insomnia and excitement**. Doses of $\frac{1}{4}$ to $\frac{1}{2}$ grain (0.015 to 0.3 Gm.) often suffice for mild sedative effects. The drug is serviceable likewise in **bronchitis, chorea, whooping-cough, dysmenorrhea, sexual irritability, and hyperthyroidism**. For more powerful effects, such as may be needed in **morphinism, puerperal eclampsia, vomiting of pregnancy, migraine, and the insanities**, doses of $\frac{3}{4}$ to $1\frac{1}{2}$ grains (0.05 to 0.1 Gm.) or even more may be required. The amount should, however, preferably not exceed 0.3 Gm. (5 grains) in one day. The drug is extensively used in **epilepsy** (*q.v.*) in doses of 1 to 4 grains (0.06 to 0.25 Gm.) a day. Excessive dosage in this disease may result in stupor or restlessness (Grossman). When the drug is discontinued, the withdrawal should be carried out gradually, otherwise an alarming increase in the seizures may occur.

S.

PHENOL, OR CARBOLIC ACID, AND DERIVATIVES.—

Phenol, phenylic or phenic acid, carbolic acid, hydroxybenzene, phenylic alcohol, or coal-tar creosote, is obtained by fractional distillation of coal-tar at 338° to 446° F. (170° to 230° C.) or made synthetically. Pure phenol occurs in long, colorless needles, melting at 95° F. (35° C.) and having a characteristic odor and, when highly diluted, a sweetish taste. Phenol deliquesces in moist air and becomes red on exposure to the light. It is freely soluble in alcohol, ether, chloroform, and glycerin, and slightly soluble in water.

The Pharmacopœia of 1890 recognized a crude acid (acidum carbolicum crudum), which is a mixture chiefly of cresol and phenol and occurs as a dark, oily liquid, having a strong tar odor, and is partly soluble in water. This crude phenol is used chiefly for disinfecting purposes, either in solution (1 in 50 to 200) or mixed with chloride of lime, slaked lime, etc.

The crystals of pure phenol may be liquefied by the addition of 5 per cent. of water, a clear solution resulting; the further addition of water produces turbidity until the proportions are approximately reversed (1 to 15 or 20), when it becomes permanently clear, unaffected by further dilution.

PREPARATIONS AND DOSES.

—*Phenol*, U. S. P. (crystals, at least 98 per cent. C_6H_5OH). Dose, 1 grain (0.06 Gm.).

Phenol liquefactum, U. S. P. (liquefied phenol, made by mixing with 10 per cent. of water—both by weight). Dose, 1 minim (0.06 c.c.).

Glyceritum phenolis, U. S. P. (glycerite of phenol; 20 per cent.). Dose, 5 minims (0.3 c.c.).

Unguentum phenolis, U. S. P. (ointment, 2 per cent. of phenol).

Among the used unofficial preparations are:—

Phenol iodatum, N. F. (iodized carbollic acid, iodized phenol, acidum carbollicum iodatum,—containing iodine, 20; phenol, 60; glycerin, 20 parts). Used externally as a counterirritant and cauterant.

Liquor sodii boratis compositus, N. F. (Dobell's solution, containing sodium borate and bicarbonate, each 1.5; phenol, 0.3; glycerin, 3.5; sterilized water, ad 100 parts). Alkaline, antiseptic solution, used where phenol is not contraindicated.

Liquor sodii carbolatus, N. F. III (caustic soda, 3.5; phenol, 50; water, ad 100 parts). Deodorant and disinfectant.

PHYSIOLOGICAL ACTION.—

Locally, phenol is an energetic caustic, in dilute solution an irritant. In concentrated form, when brought in contact with the tissues, it causes a burning sensation, quickly followed by numbness (from paralysis of the peripheral sensory nerves), blanching of the area, rapid disorganization of the part and the formation of a hard mass, which does not disappear for some time, and if left on too long may produce gangrene. Many cases of gangrene have been reported, especially where phenol was applied to the broken skin, which suggests the thought that, as it has real penetrating power through unbroken skin, it should never be covered with any material that will prevent evaporation, but should be applied only with a light dressing (Levin). If one of the extremities be immersed in a comparatively weak solution of the drug, a contraction of the capillaries and

consequent pallor of the skin result, with a certain amount of local anesthesia. Upon the mucous membrane the acid causes, first, a sensation of burning pain, then anesthesia, leaving a white eschar (Pouchet).

When administered internally in toxic doses it gives rise to convulsions of spinal origin, to which are added at first increased reflex activity. This being followed by paralysis, it is evident the spinal centers are first stimulated, then depressed. The nerves and muscles, as shown by Salkowski and Hoppe-Seyler, are not distinctly paralyzed, however, since they respond actively to galvanic stimulation (Wood). The arterial pressure is reduced and the heart depressed. Gies has shown that phenol paralyzes the vasomotor center in the medulla before affecting the heart. The condition of the blood induced in animals is one of oligocythemia rather than oligochromemia, as the reduction of blood-corpuscles is not accompanied by any alteration in the percentage of hemoglobin (W. J. Wilkinson). Respiration is at first greatly increased in frequency, owing, mainly, to a stimulating influence exerted upon the respiratory centers during the first stages and in part to stimulation of the peripheral vagi (Salkowski). As to the effects on temperature, H. C. Wood concludes, from the experiments of H. A. Hare and E. Erls, that phenol may affect the thermogenic functions in two ways: first, by diminishing the production of heat; second, by increasing the dissipation of heat.

From careful and extended experiments, Sollmann, Pilcher, and others find that when phenol enters the alimentary canal its absorption is at

first very rapid, but is quickly checked and soon practically arrested. This inhibitory effect on phenol absorption is apparently not due to its toxic action on the epithelium, but to a specific slowing of the intestinal circulation.

Phenol coagulates albumin, and in sufficiently strong solution is poisonous to all forms of life, its main use in practice depending upon its ability to destroy micro-organisms rather than as a stimulant. Phenol is excreted by the kidneys, and gives rise to dark, smoky urine, and at times suppression of the urine.

POISONING BY PHENOL (CARBOLIC ACID).—Phenol is a most deadly poison and acts rapidly. Six or seven drops have caused the most dangerous symptoms. Death may be expected to follow almost immediately after taking any large quantity. Death has taken place within ten minutes after swallowing about 1 ounce (30 c.c.) of phenol, although life may be protracted two or three days. If a large dose be swallowed one may drop dead before he can get more than a few feet from the spot where he stood or he may live a few hours. Sudden death is due to failure of respiration. If death is delayed, symptoms of violent gastroenteritis ensue.

SYMPTOMS.—The symptoms of poisoning are vertigo and intoxication, accompanied with vomiting of frothy mucus, and an intense burning pain in the mouth, esophagus, and stomach. The pupils are contracted, the pulse rapid and intermittent, and coma, collapse, or convulsions ensue. The skin is covered with a clammy sweat, the features are pinched and anxious, and the

pulse becomes very thready and almost imperceptible, as a rule. White eschars are noticed about the mouth if the pure acid has been taken, or blackish if the impure drug has been used. The odor is apt to hang about the person or clothes. The urine is frequently suppressed, but, if passed or withdrawn by catheter, is dark colored and smoky. Convulsions or coma often close the scene. A very common symptom is hoarseness of the voice, and is due to an effect on the larynx after the drug is absorbed, and not from its local influence.

Cases are on record in which phenol poisoning has been due to its absorption from surgical dressings. In these cases a darkened, smoky hue of the urine, with slight nervous unrest or cerebral disturbances, is present. Pain in the lumbar region is another indication of this condition, and should suggest the removal of the dressings.

Autopsies in cases of phenol poisoning will show the tongue, gums, and, in fact, the whole mouth are colored white. This discoloration also affects the whole alimentary tract. The mucosa of the esophagus is smooth and white and can be easily stripped from the muscularis. The kidneys show either intestinal changes or else the parenchyma of the organ is mainly involved. In most of the cases the lungs are congested and edematous. The remaining internal organs present no lesion which can be ascribed to the acid.

Von Bruns states that carbolic acid in concentrated solution is relatively less toxic than when diluted, its penetrability during its brief influence is but slight, and the bactericidal action

of pure carbollic acid surpasses that of sublimate in albuminous compounds.

Treatment of Poisoning by Phenol (Carbolic Acid).—When phenol accidentally comes in contact with the skin, wash it off quickly with **alcohol**, **whisky**, or **vinegar**. **Tincture of iodine** or an **oil dressing** may be applied in addition.

When taken internally, in the absence of excessive damage to the mucosa of the stomach, the stomach should be washed out with **warm water** or 10 per cent. **alcohol**, continuing persistently until the phenol odor disappears from the return fluid. If no **stomach-tube** is at hand, give 5 or 6 drops of a 2 per cent. solution of **apomorphine hydrochloride**.

Tincture of iodine in doses of 5 to 20 minims (0.3 to 1.3 c.c.) every four hours has been recommended as an antidote. **Syrup of lime** and **potassium permanganate** are, however, probably more effective. Confidence in **alcohol** and **sulphates** as direct chemical antidotes has greatly diminished.

Simple **lavage** with 5 per cent. **sodium bicarbonate** solution, 3 to 6 quarts, is very effective. **Magnesium sulphate**, 60 to 120 c.c. (2 to 4 ounces) of a 50 per cent. solution, should be left in the stomach. In comatose cases, the most prompt results are obtained by giving **intravenously** either **normal salt solution**, 2 per cent. **magnesium chloride** solution, or preferably, a 1.4 per cent. **sodium chloride** and 0.37 per cent. **sodium carbonate** solution, 500 to 1000 c.c. (1 to 2 pints). **Sodium bicarbonate** solution also forms the most convenient local wash. **Petrolatum** may be applied to the skin in the later stages. **Alcohol** is of use in washing off the skin, but the effects of the denaturing agent it may contain should be considered. The patient should be kept in bed until signs of

hemorrhage and renal irritation have disappeared. Gastrointestinal pain may yield to **orthoform**, 1 Gm. (15 grains); or, **morphine** may be necessary. For stimulation, **caffeine sodiobenzoate** hypodermically is effective. **Calcium lactate** may be given, especially if there is bleeding. Enough **sodium bicarbonate** and **citrate** should be given by mouth to keep the urine just alkaline to methyl red; under this measure renal irritation seems to clear up rapidly. In unconscious cases it is well not to pass the stomach tube. In *cresol* or *lysol* poisoning, similar treatment is applicable. R. Isaacs (Ohio State Med. Jour., Aug., 1922).

To eliminate the poison from the digestive tract and from the blood, give **sodium sulphate** or **magnesium sulphate**, well diluted.

Apply **warmth** and **friction** to the **extremities**. Give **flaxseed-** or **slippery elm-** tea, or **gruel**, to protect the mucosa. Give stimulant hypodermic injections of **strychnine** and **digitalin**, and support respiration and circulation with hypodermics of **atropine sulphate**, $\frac{1}{100}$ gr. (0.0006 Gm.), **adrenalin hydrochloride**, $\frac{1}{1000}$ gr. (0.00006 Gm.), or **camphor** (sterile saturated solution in oil), 30 minims (2 c.c.) every half-hour. **Strong black coffee** is also useful.

Case of a girl of 19 years who had taken 1 ounce of phenol on an empty stomach. Notwithstanding hospital treatment, 2 hours later she was almost pulseless, with cyanosis and rattling in the chest. Hypodermic use of 20 minims (1.25 c.c.) of **adrenalin** proved so beneficial that it was repeated every 2 hours to a total of 240 minims (4 drams), and the patient was well enough to go home the next day. C. F. Hayes and W. S. Horn (Tex. State Jour. of Med., Aug., 1922).

Pain may be relieved by injections of **morphine** and **counterirritation** over the abdomen. Emetics usually

will not act on account of the condition of the stomach; the stomach-tube is often contraindicated on account of the lesions along the esophagus and in the stomach. **Heat** should be applied to the extremities. **Rest in bed** should be enjoined from the beginning and until recovery.

In Landouzy's treatment of phenol poisoning, 30 to 60 minims (2 to 4 c.c.) of **ether** are at once injected hypodermically. A rectal injection of 2 ounces (60 Gm.) of **sodium sulphate** in 3 pints (1500 c.c.) of filtered water is also given, the bowel being irrigated as high as possible after the manner of Cantani.

The **removal** of 8 ounces of **blood** from the saphenous vein, the **infusion** of 4 pints (2 liters) of normal **saline solution** at a temperature of 100° F. (37.7° C.) into the vein, and **atropine sulphate**, $\frac{1}{50}$ grain (0.0013 Gm.) administered hypodermically, are advised by Oliver.

CARBOLIC ACID GANGRENE.

—See GANGRENE, Vol. IV.

THERAPEUTICS.—**Oral Disorders.**—Solutions of phenol have been recommended in **stomatitis**; a spray of 1 grain (0.06 Gm.) to the ounce (30 c.c.) of water, or a mouth-wash or gargle containing 2 to 5 grains (0.13 to 0.3 Gm.) to the ounce (30 c.c.) of water may be used. **Offensive breath** may be sweetened by the use of a 5 per cent. spray. The cavity of a **carious tooth** may be packed with a pledget of absorbent cotton dipped lightly in a concentrated solution of phenol to relieve the pain. In **diphtheria** and **fetid sore throat** a 2 to 5 per cent. solution may be used with brush or atomizer.

Gastrointestinal Disorders.—In **nervous vomiting** or that due to gas-

tric irritation $\frac{1}{2}$ -to 2-drop doses will afford relief by the depressant action of the acid on the nerves of the stomach. **Fermentative diarrhea** is well treated by giving 2 to 4 drops of phenol combined with 10 to 20 grains (0.6 to 1.3 Gm.) of bismuth in powder or capsule. **Cholera infantum** and **cholera morbus** are amenable to similar treatment if fermentation is present. **Vomiting after ether** can be stopped by giving $\frac{1}{4}$ drop of phenol every hour for a few hours.

Respiratory Disorders.—Weak solutions of phenol are of value in **chronic and atrophic rhinitis**, **coryza**, **hay fever**, and **influenza**; the solution (2 to 5 grains—0.13 to 0.3 Gm.—to the ounce—30 c.c.) is best used in spray. The familiar "Dobell's solution" (liquor sodii boratis compositus, N. F.) is used for cleansing the nares previous to making applications.

A solution (5 to 15 drops of phenol to the ounce—30 c.c.—of water) inhaled by means of very fine spray is beneficial in **gangrene of the lung** and in **pulmonary tuberculosis**; it controls the cough and relieves the tickling in the throat. For this use, however, creosote is to be preferred.

Fevers and Septic Disorders.—A favorite treatment for **enteric fever** with some is a combination of 1 part of phenol and 2 parts of **tincture of iodine**; 2 or 3 drops are given in mint-water every three or four hours.

Cutaneous Disorders.—In **parasitic skin diseases** phenol may be applied in $\frac{1}{2}$ to 2 per cent. solution: **Scabies**, **favus**, **tinea tonsurans**, **tinea circinata**, **pityriasis versicolor**, etc. In most of these diseases other remedies are preferable. In **subacute eczema** when there is a great amount of weeping and itching, a cerate of 10 grains

(0.65 Gm.) of phenol to 1 ounce (30 c.c.) of simple cerate has been recommended.

In a case of **leucoderma** treated by phenol there were numerous white patches surrounded by zones of brown pigmentation in the groins, on the abdomen and the legs, over the sacrum, the nape of the neck, and in the armpits were patches of brown discoloration only. The patches on the nape of the neck and the sacrum were painted by Savill with pure phenol. The skin resumed its normal pink color after three weeks.

A good dressing for **burns** consists of phenol and carron oil (4 grains—0.25 Gm.—of phenol to each ounce—30 c.c.—of oil). B. F. Gardner applies the pure acid to burns and then cleanses with sterilized water.

Erysipelas has been treated by subcutaneous injections of a 2 per cent. solution of phenol. These have also been used in **actinomycosis**.

Good results are obtained from phenol in **erysipelas**, by the subcutaneous injection of a solution containing equal parts of glycerin and phenol. A dose of $\frac{7}{8}$ grain (0.05 Gm.) is employed and has been found satisfactory as an analgesic and antithermic.

An ointment containing phenol and camphor has been used to mitigate the severe **pruritus accompanying variola** and to **prevent pitting**. As soon as the papules develop into vesicles the surface is scrubbed with soap and water, and followed by solution of hydrogen dioxide. The vesicles are then opened, the fluid allowed to escape, and the cavity touched with pure carbolic acid; the surface is again washed with solution of hydrogen dioxide, oiled, and covered

with cloths wrung out of phenolized water.

In many pruritic diseases, as **papular eczema**, **psoriasis**, **lichen**, and **urticaria**, or nettle rash, J. V. Shoemaker advised: Phenol, 5 to 10 drops; sublimed sulphur, $\frac{1}{2}$ dram (2 Gm.); camphor, 10 grains (0.6 Gm.); zinc ointment, 1 ounce (30 Gm.). This is to be applied frequently to the irritable surface.

Lotions containing phenol allay the **itching which accompanies jaundice**. Hare recommends: Phenol, 10 grains (0.6 Gm.), olive oil, 4 drams (15 c.c.). This to be applied frequently.

Surgical Disorders.—Phenol solution (1 to 20) has been used in surgery as an antiseptic lotion and also to keep instruments in while operating (corrosive sublimate and other antiseptics have almost entirely replaced it for the latter purpose).

For the dressing of **wounds**, phenol has been used in the form of lotion, phenolized oil, gauze, and spray. As a **local anesthetic** for minor operations (**removing toe-nail**, **opening felon**, **incising carbuncle**, etc.), it may be used by soaking the part for ten minutes in a strong solution, and afterward applying the pure phenol on a brush to the line of incision.

The injection of uncomplicated **hemorrhoids** with a 5 to 10 per cent. solution of phenol will relieve the pain; the tumor gradually shrivels up and normal defecation is at once established. Where there are several, each should be separately injected.

Local applications of pure phenol give good results in **tuberculosis of bones and joints**. The diseased tissue is carefully removed as far as possible, and concentrated phenol is applied and permitted to remain for one

or one and a half minutes, the healthy tissues being suitably protected. The phenol is then removed with pledgets of absorbent cotton, and then washed off with alcohol.

Pure phenol is an excellent application to **carbuncles** or **malignant pustule** after incision and curetting; it acts both as an antiseptic and anesthetic.

Four injections of a 2 to 3 per cent. solution into the center of a **boil** will usually bring about resolution.

For **urethral caruncle**, injections of 20 drops of a mixture of equal parts of phenol and glycerin combined with 80 drops of water may be employed.

Camphorated phenol diluted with 50 per cent. of cottonseed oil may be used with excellent results as a dressing for ulcerating **epithelioma**.

Lupus erythematosus has been cured by the continued use of undiluted phenol, which was painted over the edges of the patches once or twice a week, and boric acid ointment (4 per cent. boric acid) applied daily, and especially after applying the acid. Drop doses of Pearson's solution of arsenic (liquor sodii arsenatis, U. S. P.) were also given with nux vomica and tincture of orange-peel.

S. Sherwell, of Brooklyn, treats **nevi** by tattooing them with needles dipped into a 50 per cent. solution of phenol, afterward cleansing the surface with alcohol, and finally applying a layer of collodion. The results are said to be excellent, little or no scarring being left.

Non-suppurating **enlarged glands** may be treated by parenchymatous injections of 5 to 10 drops of a 2 per cent. solution of phenol. **Buboes** may be similarly injected with 10 minims (0.6 c.c.) of the same solution, the

skin being first benumbed by an ether spray. This treatment is also good in **chronic synovitis** (repeated every three days), and for **boils** and **carbuncles** if used early enough to abort the trouble.

For the cure of **hydrocele**, R. J. Levis advised injecting into the tunica vaginalis 15 to 20 minims (1 to 1.3 c.c.) of pure phenol, after withdrawing the fluid.

Tetanus has been successfully treated by hypodermic injections of a 1 to 2 per cent. solution of phenol, conjoined with warm baths and enemata containing chloral and potassium bromide, 12 drops being injected every three hours. After two days of this treatment a marked improvement usually manifests itself. Injections are continued until twenty-eight have been given.

Disinfectant.—As a disinfectant, phenol is only of moderate effectiveness; although a 2 per cent. solution will kill most spores and germs, many resist, and even a 5 per cent. solution requires more than twenty-four hours to kill the spores of anthrax. In all cases of disinfection by carbolic acid an exposure *by contact of some duration* is necessary. As an adjunct to other disinfection, the walls and floors of infected rooms may be scrubbed with a solution of phenol not weaker than 2 per cent. For the disinfection of wounds phenol has been replaced by other remedies, which are as efficient and less harmful, as a deodorized phenol is practically inert.

Lenti's study of the relative value of disinfectants gave the following results: 1. Alcohol in the absence of water neutralizes all bactericidal power on the part of mercuric chlo-

ride or phenol with regard to anthrax spores. The bactericidal action is not exercised until the dilution of the alcohol with water is greater than 2 per cent. in the case of 1:1000 sublimate solution, or than 70 per cent. in the case of phenol. 2. Glycerin interferes with the action of a 2:1000 solution of mercuric chloride if the proportion of water be less than 40 per cent. In the case of phenol it is still more manifest. 3. Phenol and lysol dissolved in olive oil has no disinfecting action.

DERIVATIVES AND ALLIED COMPOUNDS.—Aseptol, or Sozolic Acid.—This is a $33\frac{1}{3}$ per cent. solution of orthophenolsulphonic acid. It occurs as a clear, yellow to yellowish-brown liquid; has the odor of phenol; is soluble in alcohol, glycerin, and in all proportions in water; and possesses antiseptic properties. It is used as a disinfectant. It is claimed that it is free from all toxic effects, yet more efficient than phenol. It has been used externally in diseases of the bladder, eye, and skin, and in diphtheria, laryngitis, gingivitis, etc., in solutions of from 1 to 10 per cent. It should be kept from the light. Internal adult dose, 10 to 20 grains (0.6 to 1.3 Gm.).

Bromphenol.—This is a fluid analogous to chlorphenol, bromine taking the place of chlorine. It has a purple color and has less of the phenol odor than chlorphenol. Like chlorphenol, it is freely soluble in water, alcohol, and alkaline fluids. Like chlorphenol, in the form of a 2 per cent. ointment it has given excellent results in erysipelas. (I. Tschourilow.)

Bromol, or Tribromphenol.—This is obtained by the action between an aqueous solution of phenol and bro-

mine-water. It occurs in white to reddish crystals, of a disagreeable bromine odor, and has a sweet, astringent taste. It is insoluble in water, but soluble in alcohol, glycerin, ether, chloroform, and oils. It has been used in daily doses of $1\frac{1}{2}$ to $7\frac{1}{2}$ grains (0.1 to 0.5 Gm.) in **cholera infantum**, **typhoid fever**, etc., and locally to **purulent wounds** in oily solution (1 to 30) or in ointment (1 to 8), and in diphtheria in 4 per cent. solution in glycerin. Bromol has given Rade-maker good results in **diphtheria**, in a glycerin solution of the strength of 1 in 25, locally applied. It may also be used in **cholera infantum**, in doses of from $\frac{1}{12}$ to $\frac{1}{4}$ grain (0.005 to 0.015 Gm.).

Chlorphenol.—This is a liquid obtained by the action of chlorine-gas upon phenol. It is a mixture of chlorphenols, and is a dense volatile fluid of pleasant odor. It has been used in the treatment of **tuberculosis**, **chronic bronchitis**, **bronchorrhea** and **gangrene of the lung**, **ozena**, and **laryngitis** (Passerini), by inhalation, the daily dose being from 20 to 30 drops. It has also been used locally on **ulcers** and in **purulent otitis** and **abscess of the antrum of Highmore**.

Trichlorphenol, or Trichlorophenol.—This is obtained from phenol by the action of chlorine. It occurs in white needles, soluble in alcohol and in ether, and slightly soluble in water. It is used locally in the treatment of **diphtheritic ulcers**, **erysipelas**, **chancres**, etc., in the form of a 5 to 10 per cent. solution or ointment.

Diaphtherin, or Oxyquinaseptol.—This is a yellow, crystalline powder, soluble in water and in dilute alcohol, and is a non-poisonous antiseptic. It is used in $\frac{1}{2}$ to 2 per cent. solutions or

as a dusting powder for dressing **wounds, ulcers, burns, etc.**, in **external and median otitis** and in **eczema of the ear and nose**. In solution it does not stain the hands, but it blackens steel instruments. This discoloration can be easily removed. Diaphtherin possesses decided germicidal powers. A solution of the strength of 0.3 per cent. and one of 0.1 per cent. were sufficient to kill the *Staphylococcus pyogenes aureus* in the course of fifteen minutes and forty-five minutes, respectively.

Diaphtol, or Quinaseptol.—This occurs in yellowish-white crystals, soluble in 35 parts of boiling water, and slightly soluble in cold water. It has antiseptic and antifermentative properties and is used in solution to **disinfect the urinary tract**. It prevents the decomposition of urine better than salol.

Diaphtol is slightly toxic, but does not give rise to gastric or intestinal irritation. It is eliminated unchanged by the kidneys.

Phenosalyl.—This is a mixture of phenol, 90 parts; salicylic acid, 10 parts; lactic acid, 20 parts; and menthol, 1 part, united by heat. It has been used externally in solution, in conjunctivitis (in 0.2 to 0.4 per cent.), in **eczema** (in 1 per cent.), and in **purulent cystitis** (in 2 per cent.). Phenosalyl possesses antiseptic powers superior to the antiseptics usually employed, with the exception of corrosive sublimate. A solution of 1 per cent. suffices to kill the most resisting microbes in one minute. It has the great advantage of being non-toxic, experiments showing it to be four times less toxic than carbolic acid and a hundred times less than corrosive sublimate.

Clinical experiments with the drug were made at the Hôtel-Dieu, in Paris, in the service of Cornil, upon more than one hundred patients, who were mostly affected with genito-urinary troubles, as **endometritis, erosions of the cervix, vaginitis, and urethritis**. In every case, even inveterate ones, its use was followed by rapid recovery. In several cases of **puerperal infection** it caused the fever and other symptoms to rapidly disappear. For surgical use, injections, irrigations, etc., phenosalyl is employed in aqueous solutions of from $\frac{1}{2}$ to 1 per cent. These do not injure the instruments nor irritate the skin.

Saprol.—This is a mixture of coal-tar constituents, proposed as a cheap disinfectant. It occurs as a dark-brown, oily fluid. When added to water it floats. In 1 per cent. solution it is well adapted for the disinfection of dejecta in barracks, prisons, and schools. Of all disinfectants advocated for rendering infected stools and cess-pools innocuous, saprol most nearly answers all requirements. It forms no inefficacious compound on admixture, and readily diffuses itself among the excreta.

Tricresol is a mixture of ortho-, meta-, and para- cresols from coal-tar. It is a colorless, oily liquid, soluble in about 40 parts of water. It is a germicide and antiseptic, and does not attack instruments or benumb the hands. It is much less irritant and less poisonous than phenol or mercury bichloride. In 1 per cent. solution or ointment it is used in skin diseases and for surgical dressings. In weak solution (1:500 or 1:1000) it has been found useful as an antiseptic collyrium in ophthalmic practice.

Phenolsulphonates.—Zinc phenolsulphonate occurs as clear, colorless crystals, or a white powder, soluble in 1.7 parts of water. It has been employed as a mild local stimulant to **foul, sluggish ulcers or open wounds** and to **mucous membranes subacutely inflamed**, in powder or in solution, and in $\frac{1}{2}$ to 1 per cent. solution as an injection in **gonorrhea**. It is sometimes given as a gastrointestinal antiseptic in **fetid diarrhea** and in **typhoid fever**, in doses of 1 to 3 grains (0.06 to 0.2 Gm.) 4 or 5 times daily.

Sodium phenolsulphonate occurs in clear, colorless crystals, with a slightly bitter taste, and soluble in 6 parts of water. As an antiseptic it has been used internally in **dyspepsia, tuberculosis, cholera, typhoid fever, flatulence, dysentery**, etc., in doses of 8 to 30 grains (0.5 to 2 Gm.).

The phenolsulphonates are probably voided by the intestines unchanged. Their properties as gastrointestinal antiseptics appear to have been overrated.

[Other derivatives of phenol may be found under CREOSOTE, Volume III.]

C. SUMNER WITHERSTINE,
Philadelphia.

PHENOLPHTHALEIN, *Phenolphthaleinum*, U. S. P. (dioxyltriphenylphthalide; paraphthalein)— $C_{20}H_{14}O_4$ —is obtained from phthalic anhydride by treating it with concentrated sulphuric acid. It occurs as a yellowish-white or almost white micro-crystalline powder, soluble in 10 parts of alcohol and in 600 parts of water. The 1 per cent. alcoholic solution is colorless. Its solution in acid liquids is also colorless, but a red color appears when the solution is made alkaline.

It is useful as an indicator for caustic alkalies in the presence of alkaline carbonates; also for detecting alkaline carbonates in the presence of alkaline bi-

carbonates, for titrating organic acids, etc., and for testing margarine.

PHYSIOLOGICAL ACTION.—Phenolphthalein appears to have but one action—that of a laxative and purgative. Although it has been given in doses up to 30 grains (2 Gm.), a case of poisoning from taking 15 grains (1 Gm.) has been reported. According to Hydrick, even small doses induce a slight albuminuria persisting one to three days. Schliep has asserted that the drug may cause a hemorrhagic nephritis. It is known occasionally to cause a skin eruption.

Case of skin eruption in a girl of 18 years, who had been taking regularly a preparation known as "ex-lax." Numerous slightly grouped macular patches were scattered over the trunk, most numerous on the lateral surfaces. They varied from $\frac{1}{2}$ inch to several inches in diameter; their color varied from purple to bright red, the larger plaques being somewhat raised. These began to fade after a dose of **calomel**, but returned with the administration of 1 grain (0.065 Gm.) of phenolphthalein. Netherton (*Med. Jour. and Rec.*, June 4, 1924).

THERAPEUTIC USES.—This remedy is used medicinally as a laxative in **constipation** in doses of from 1 to 8 grains (0.06 to 0.5 Gm.); the larger doses (5 to 8 grains—0.3 to 0.5 Gm.) are needed only in obstinate cases or in bedridden patients. In **gall-stone disease** phenolphthalein has frequently been used, either alone or combined with calomel, or with aloin, strychnine, belladonna, and ipecac. When it is combined with calomel, the possible need of administering a cathartic after the calomel is obviated. W.

PHOSPHORIC AND HYPOPHOSPHOROUS ACIDS.—Phosphoric acid as used in medicine is orthophosphoric acid. The official acid is a colorless, syrupy liquid, without odor, having an intensely acid taste. It is soluble in all proportions in water and in alcohol. When heated above 392° F. (200° C.) it changes into pyrophosphoric acid. With the

metals and the alkalis these acids form phosphates and pyrophosphates.

Hypophosphorous acid is a clear, colorless or slightly yellow, and odorless, sour liquid, miscible in all proportions with water, and is decomposed at high temperatures. With the metals and the alkalis hypophosphorous acid forms hypophosphites.

PREPARATIONS AND DOSES.

—The recognized preparations are:—

Acidum hypophosphorosum, U. S. P. (30 to 32 per cent. absolute acid). Dose, 3 minims (0.2 c.c.).

Acidum phosphoricum, U. S. P. (phosphoric acid, 85 to 88 per cent. absolute orthophosphoric acid). Used to prepare the diluted acid.

Acidum phosphoricum dilutum, U. S. P. (diluted phosphoric acid; 9.5 to 10.5 per cent. absolute acid). Dose, 10 to 60 minims (0.6 to 4 c.c.).

Ferri phosphas solubilis, U. S. P. (soluble ferric phosphate; this salt should contain ferric phosphate corresponding in amount to not less than 12 per cent. of metallic iron). Dose, 4 to 10 grains (0.25 to 0.6 Gm.).

Sodii phosphas, U. S. P. (sodium phosphate; should contain Na_2HPO_4 corresponding to not less than 99 per cent. of crystallized disodium orthophosphate— $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$). Dose, 1 to 8 drams (4 to 30 Gm.).

Sodii phosphas effervescens, U. S. P. (effervescent sodium phosphate; contains exsiccated sodium phosphate, 20 per cent.). Dose, 1 to 4 drams (4 to 15 Gm.).

Sodii phosphas exsiccatus, U. S. P. (dried sodium phosphate; should contain not less than 98 per cent. of pure anhydrous sodium phosphate). Dose, 30 grains (2 Gm.).

Sodii biphosphas, U. S. P. (sodium biphosphate; should contain, when

dried to constant weight at 100°C ., not less than 98 per cent. of NaH_2PO_4 ; contains not more than 15 per cent. of water; it is acid to litmus paper). Dose, 10 grains (0.6 Gm.).

Calcii hypophosphis, N. F. (calcium hypophosphite; should contain not less than 98 per cent. of pure calcium hypophosphite. Trituration or heating with nitrates, chlorates, or other oxidizing agents causes an explosion). Dose, 5 to 30 grains (0.3 to 2 Gm.).

Ferri pyrophosphas solubilis, N. F. (soluble ferric pyrophosphate; this corresponds in amount to not less than 10 per cent. of metallic iron). Dose, 4 to 10 grains (0.25 to 0.6 Gm.).

Potassii hypophosphis, N. F. (potassium hypophosphite; should contain not less than 98 per cent. of pure potassium hypophosphite. Explosion caused when triturated or heated with nitrates, chlorates, or other oxidizing agents). Dose, 5 to 15 grains (0.3 to 1 Gm.).

Sodii hypophosphis, N. F. (sodium hypophosphite; should contain not less than 98 per cent. of pure sodium hypophosphite. Explosion caused when triturated or heated with nitrates, chlorates, or other oxidizing agents). Dose, 10 to 30 grains (0.6 to 2 Gm.).

Syrupus calcii lactophosphatis, N. F. (syrup of calcium lactophosphate). Dose, $2\frac{1}{2}$ drams (10 c.c.), equivalent to about $3\frac{1}{2}$ grains (0.26 Gm.) of calcium phosphate.

Syrupus hypophosphitum, N. F. (syrup of hypophosphites). Dose, $2\frac{1}{2}$ drams (10 c.c.), containing $6\frac{1}{2}$ grains (0.45 Gm.) of calcium hypophosphite, and $2\frac{1}{8}$ grains (0.15 Gm.) each of potassium and sodium hypophosphites.

Calcii phosphas præcipitatus, N. F. (precipitated calcium phosphate; should

lose, when dried at 200° C., not more than 4 per cent. of moisture). Dose, 5 to 30 grains (0.3 to 2 Gm.).

Ferri hypophosphis, N. F. (ferric hypophosphite; should contain not less than 98 per cent. of pure ferric hypophosphite). Dose, 3 to 10 grains (0.2 to 0.6 Gm.).

Syrupus hypophosphitum compositus, N. F. (compound syrup of hypophosphites). Dose, 2 drams (8 c.c.), containing quinine, $\frac{1}{8}$ grain (0.009 Gm.); strychnine, $\frac{1}{80}$ grain (0.0009 Gm.); hypophosphite salts of calcium, 4 grains (0.28 Gm.), of potassium and sodium, each 2 grains (0.14 Gm.), and of iron and manganese, each $\frac{1}{4}$ grain (0.018 Gm.).

Syrupus ferri, quinae et strychninae phosphatum, N. F. (syrup of the phosphates of iron, quinine and strychnine). Dose, $\frac{1}{2}$ to 1 dram (2 to 4 c.c.).

Acidum hypophosphorosum dilutum, U. S. P. IX (diluted hypophosphorous acid; 10 per cent. absolute acid). Dose, 5 to 10 minims (0.3 to 0.6 c.c.).

PHYSIOLOGICAL ACTION.—Pure phosphoric acid is a local irritant and escharotic. Taken internally, well diluted, it is asserted to stimulate the stomach and aid digestion. It stimulates the appetite, increases the salivary secretion, and has been regarded as a general tonic. In large doses it acidifies the urine. Hypophosphorous acid acts in a similar manner.

Martinet holds that substances containing phosphorus (glycerophosphates, lecithin, phosphoric acid) fix it in the organism and stimulate proliferation of cellular elements, *i.e.*, the division of nuclei and changes in cell multiplication. They produce a general dynamogenic action.

According to F. Cautra, phosphoric acid has no toxic action.

The effect of ingestion of sodium phosphate on the capacity for muscular work was tested by Eimben, Grafe and Schmitz (Zeit. f. phys. Chem., Mar. 30, 1921). Experiments in men, carried out with the ergograph, and with precautions to exclude extraneous factors, showed invariably an increased capacity for work after ingestion of phosphate solutions. Two battalions of soldiers, approximately equal in marching ability, were also experimented upon, the men of 1 battalion being given phosphate beverages and those of the other tartaric acid beverages. A decided superiority in favor of the former was noted in a hard four days' march; the difference was already apparent on the first day, and became more marked on the subsequent days. After extra large amounts of the phosphate, euphoria and insomnia were observed.

THERAPEUTICS.—The dilute acids in doses of 20 to 60 drops have been used as tonics and gastric stimulants. They are probably useful in **nervous exhaustion** in aiding digestion by stimulating the stomach. In all debilitated conditions, as **anemia**, the exhaustion of **prolonged lactation**, and in **bronchial catarrh of the aged**, they have been deemed useful. Like the mineral acids, they should be given before meals in **hypoacidity of the stomach**. Phosphoric acid may be preferred to the mineral acids in **typhoid fever** when nervous prostration is a prominent symptom. The dilute acid may be used as a stimulant to **indolent ulcers**.

Cautra states that the morbid conditions in which phosphoric acid is most beneficial are those in which there is **demineralization of the organism** with **hypoacidity of the urine**. It is especially effectual when the nervous system seems to have partially lost its resisting power. True **neurasthenia**, for instance, is accom-

panied by considerable elimination of the alkaline phosphates in the urine, the logical consequence of the exaggerated consumption of phosphoric acid occasioned by the over-exertion of the brain. The nervous balance cannot be restored until the lost phosphorus has been replaced. In neurasthenics in whom the nerve-cells are secondarily affected from some digestive or other trouble, the urine will be found hypoacid with phosphaturia, and the phosphoric acid may be required for years. In **arthritis, rheumatism, tuberculosis, malaria, dyspepsia, etc.**, during the phases accompanied by demineralization of the organism, phosphoric acid will be found surprisingly effective, as also in the **nervous troubles of pregnancy and over-rapid growth.**

In skin diseases the phosphates and hypophosphites may often be substituted for arsenic, with advantage. In **boils and carbuncles, in acne indurata or inveterata, in psoriasis, and in eczema of nervous origin** calcium phosphate or the alkaline hypophosphites are valuable.

Calcium hypophosphite and the precipitated calcium phosphate are of value in the treatment of **scrofulosis, struma, and rachitis.** The hypophosphites and lactophosphites are found useful in **rickets** and in **slow and delayed union of fractured bones.** In **dental caries** and the **anemia of nursing women, in general debility and nervous prostration, and in hepatic torpor** they will do good.

The lactophosphates and hypophosphites are simply convenient modes of administering calcium, potassium, and other substances, while phosphorus acts as a stimulant to bone-growth and not by its deposition

in the bone; this difference between these salts and phosphorus should be clearly borne in mind. (Hare.)

Sodium phosphate is considered by Bartholow the best remedy in **hepatic cirrhosis and jaundice**, in doses of 20 grains to 2 drams (1.3 to 8 Gm.) in single dose or repeated several times a day, according to the laxative effect desired. Hare recommends sodium phosphate for bottle-fed children, who continually **alternate between diarrhea and constipation**, added in doses of 2 to 4 grains (0.13 to 0.25 Gm.) to each bottle of milk.

The hypophosphites have been largely used in the treatment of **incipient phthisis.** R. W. Gardner, of New York, has followed out the suggestions of Churchill, in the preparation of various syrups of the single hypophosphites. Churchill advises against a combination of different hypophosphites because the different bases are indicated in different stages of the disease: Soda in the incipient stage; lime in the second and third stages; quinine hypophosphite in the initial treatment of far-advanced cases, to be followed by lime or soda later on; lime reduces expectoration; soda favors expectoration; the tendency of the hypophosphites is to create plethora; therefore discrimination in dosage is necessary, when there is any tendency to pulmonary hemorrhage.

C. SUMNER WITHERSTINE,
Philadelphia.

PHOSPHORUS.—Phosphorus is a non-metallic element. In the state of combined phosphoric acid it is contained in the ancient unstratified rock and in the lavas of modern times. As these disintegrate and

crumble down into the fertile soil, the phosphates pass into the plants and ultimately as food into the bodies of man and animals. The earthy phosphates communicate rigidity to the bony skeleton.

Phosphorus was discovered in 1669, by Brandt, of Hamburg, who obtained it from urine. A century later Gahn showed that it was a constituent of bone. When pure, phosphorus very much resembles imperfectly bleached wax and is soft and flexible at common temperatures. It occurs in yellowish, semitransparent sticks, which have a waxy luster when cut. It is luminous in the dark and when exposed to the air. It is soluble in 25 parts of chloroform, very soluble in carbon disulphide (the solution being dangerously inflammable), in 50 parts of any fixed oil, in 80 parts of ether, and in 350 parts of absolute alcohol, but practically insoluble in water.

PREPARATIONS AND DOSES.

—The official preparations are:—

Phosphorus, U. S. P. (phosphorus). Dose, $\frac{1}{100}$ to $\frac{1}{20}$ grain (0.0006 to 0.003 Gm.).

Pilula phosphori, U. S. P. (phosphorus, $\frac{1}{100}$ grain—0.0006 Gm.) Dose, 1 to 2 pills.

The unofficial preparations, much used, are:—

Elixir phosphori, N. F. (phosphorus, 0.025 per cent.). Dose, $\frac{1}{2}$ to 2 drams (2 to 8 c.c.).

Elixir phosphori et nucis vomicæ, N. F. (elixir of phosphorus and nux vomica). Dose, 1 dram (4 c.c.), representing 2 minims (0.12 Gm.) tincture nux vomica and $\frac{1}{60}$ grain (0.001 Gm.) phosphorus.

Oleum phosphoratum, N. F. (phosphorus, 1 per cent.). Dose, 1 to 5 minims (0.06 to 0.3 c.c.).

Spiritus phosphori, N. F. III (tincture of phosphorus, containing phosphorus 0.12 per cent.). Dose, 1 to 8 minims (0.06 to 0.5 c.c.).

Liquor phosphori (Thompson's) N. F. (Thompson's solution of phosphorus, containing $\frac{1}{25}$ grain—0.0027 Gm.—of phosphorus in each dram—4 c.c.). Dose, 10 to 60 minims (0.65 to 4 c.c.).

PHYSIOLOGICAL ACTION.—

Phosphorus being a constituent of most tissues, it exerts a stimulating influence, when administered in small doses, upon their nutrition. This is particularly marked as regards the nervous and osseous systems. When, however, it is administered in toxic doses, it gives rise to changes in the metabolism which Münzer has summarized as follows, after an analysis of 15 cases of acute poisoning: During the first two or three days after the poison is swallowed there is a marked diminution in the total amount of nitrogen present in the urine, attributed not to the specific action of the phosphorus, but to the persistent vomiting and consequent state of starvation. On the second or third day after the poison is taken a marked increase in the excretion of nitrogen takes place, attributable to excessive destruction of tissue-proteids caused by the phosphorus. Usually death quickly occurs as soon as the amount of nitrogen has become very great; but in many cases there is a diminution both in nitrogen and of the quantity of urine excreted during the last hours of life. As regards the percentage of urea, if it is below 85 to 90 per cent. of the total amount of nitrogen excreted, disease of the liver, of such a kind as to interfere with its urea-

forming function, is thereby indicated, the absent urea being replaced by an excess of ammonia, which ought to have been converted into urea. But in some of the cases observed the quantity of urea excreted, after having been reduced very low, was subsequently increased three-fold, although the condition of the liver was progressively becoming worse. The view taken is that the excess of ammonia is solely due to the development of acid products in the tissues, caused by the toxic action of the phosphorus, and not to arrest of the urea-forming function of the liver. In addition to the increase in ammonia, there is excess of uric acid excreted in cases of acute phosphorus poisoning during the stage of rapid proteid metabolism, and also of nitrogenous extractives.

The chlorides of the urine are rapidly diminished after the acute toxic effects of phosphorus develop. The excretion of phosphoric acid is increased during the first few days; afterward it progressively diminishes until death.

The excretion of sulphuric acid, upon the whole, runs the same course as that of phosphoric acid; ether sulphates are increased. No fatty acids—tyrosin, leucin—nor sarcosolactic acid were found, nor any diamines. Chemical analysis of the brain-substance showed an increased percentage, and of the liver a decreased percentage, of phosphoric acid.

While hydrogen phosphide gas gives rise to the same toxic effects as those of phosphorus, red phosphorus is not poisonous; consequently the cause of the toxic quality of white phosphorus must lie in the

production of hydrogen phosphide when in contact with living tissues. In other words, when white phosphorus is introduced into the digestive tract phosphoretted hydrogen is given off, which, being easily absorbed, passes into the blood and gives rise to disturbances which prevent hematosis. This pathogenesis being granted, a new method of treatment is to be followed, which consists in acting against the formation and absorption of hydrogen phosphide.

The physiological action of phosphorus in chronic poisoning was outlined in the section on diseases of the mouth, lips, and jaw. (See NECROSIS, PATHOLOGY, volume vi.)

Experiments were made upon dogs which were poisoned by gradually increasing doses of phosphorus, given hypodermically in oil. Immediately after death the nervous tissues were fixed in corrosive-sublimate solution and stained by Nissl's method and its modifications, and with Biondi-Heidenhain solutions. In three dogs thus treated, E. Rossi found varied and diffuse changes of the cellular elements of the nervous system and of their elementary constituents. The changes in the spinal cord increased gradually from the anterior to the posterior roots. The anatomopathological process consisted in a primary degeneration of the corticomedullary cells, of those of the cerebellum and of the spinal ganglia, with a varying amount of participation of the chromophilic substance of the dendrites. No changes were observed in the neuroglia nor in the blood-vessels.

POISONING.—Poisoning by phosphorus may be acute or chronic.

Acute poisoning may occur from

an overdose of any preparation of unoxidized phosphorus, or from swallowing phosphorus paste used for destroying vermin, or from chewing the tops of lucifer matches. Red phosphorus, an allotropic form made by heating (464° to 482° F.— 240° to 250° C.) phosphorus for fifty hours in an atmosphere which is unable to act upon it chemically, is not poisonous, and has replaced to a large extent the yellow variety in the manufacture of matches. In acute poisoning the rapidity with which the symptoms appear varies. Generally in from one to eight or ten hours the peculiar, disagreeable taste of phosphorus is noticed in the mouth and the breath is heavily laden with its odor. An intense warmth in the esophagus, stomach, and bowels develops gradually into a violent, burning pain, which extends all over the abdomen. Eructations having a garlicky odor, succeeded by nausea, vomiting, and purging now follow. The vomited matters at first consist of food and later of mucus, bile, and, perhaps, blood; the color of the vomited matter is usually dark, the odor of phosphorus is present, and it with the dejecta may be luminous in the dark, owing to the presence of phosphorus. The pupils are dilated, the abdomen distended, the extremities cold, the pulse weak, and the thirst intense. Constipation is sometimes present instead of purging. Very soon the liver increases in size and is the seat of pain and tenderness.

After a lapse of twenty-four or forty-eight hours the symptoms abate and symptoms of acute yellow atrophy of the liver develop. Jaundice appears first in the conjunctivæ, and

then extends over the whole body. Vomiting and pain now return; "coffee-ground" matter is vomited, showing the presence of altered blood. The bowels are now confined, or, if moved, the stools are clay-colored, showing the absence of bile. Bile is also absent from the vomited matter. The urine is often retained. Nervous symptoms develop—muscular twitching, headache, vertigo, delirium, and convulsions or coma—and death ensues. If the patient survive the acute stage, he generally dies of general fatty degeneration of the internal organs. Recovery is rare.

The smallest doses of phosphorus known to have destroyed life were $1\frac{1}{2}$ grains (0.10 Gm.) in a man, $\frac{1}{8}$ grain (0.008 Gm.) in a woman, and $\frac{1}{50}$ grain (0.0013 Gm.) in a child. Death in cases of acute poisoning usually takes place within three to six days. In one recorded case death occurred in half an hour. Chronic cases may last for months or even years.

Chronic poisoning may result from exposure to phosphorus-fumes in match and other factories, or from the long-continued use of large doses of the drug. The most common symptoms of chronic poisoning by phosphorus are: fatigue, abdominal pains, anorexia, dyspepsia, diarrhea, sometimes obstinate constipation, intermittent headache, more or less cough, and necrosis of the lower jaw, if the teeth are carious, attended by swelling and distention of the gums with pus (see MOUTH, LIPS, AND JAWS, DISEASES OF). The complexion becomes sallow. The skin may be the seat of an eruption. The hair falls out. There is an increase of phosphates in the urine.

Treatment of Phosphorus Poisoning.—Since absorption of phosphorus is relatively slow, copious **gastric lavage** should be availed of even in cases not seen for two hours after the ingestion of the poison.

As for chemical antidotes, the researches of E. Q. Thornton have seemed to show that the use of copper sulphate is not free of danger, and that the best antidotes are **potassium permanganate** and **hydrogen dioxide**, which act chemically by oxidizing the phosphorus. Thornton prefers potassium permanganate because hydrogen dioxide is too slow in its action. The permanganate is used in a $\frac{1}{2}$ to a 1 per cent. solution by mouth (which must be given in excess, from the fact that a large portion of the permanganate is reduced by the organic substances in the stomach), or a 1:1000 solution may be used to wash out the stomach. A pint of this latter solution has been used with success a half-hour after the poison was taken.

Since large doses of potassium salts are toxic, **sodium permanganate** may advantageously be substituted. Experiments in animals showed this to be as effective as the potassium salt, and applicable without danger in larger doses. In phosphorus poisoning **irrigation of the stomach** with a 0.2 per cent. solution, leaving a pint of the solution in the stomach, is advised by Schreiber.

Oils must be avoided in all cases, as phosphorus dissolves in them and thus absorption is favored. **Old turpentine** is deemed useful by some; it is used preferably after an **emetic** (**cupric sulphate**, 3 grains—0.2 Gm. —well diluted, repeated every five minutes until vomiting occurs), and

should be given several times daily in doses of 8 minims (0.5 c.c.).

Dogs given 0.5 Gm. of phosphorus in liquid petrolatum showed symptoms only for 3 hours, while those receiving the same dose in cottonseed oil or castor oil died. In poisoned dogs receiving after 1 hour magnesium sulphate, castor oil, or liquid petrolatum, only the third group survived. Liquid petrolatum was also found capable of prolonging life even after phosphorus had been given in cottonseed oil. The writer therefore recommends **liquid petrolatum**, together with **lavage**, in acute phosphorus poisoning. It might also delay absorption in other forms of poisoning. H. V. Atkinson (Jour. of Lab. and Clin. Med., Dec., 1921).

The administration of **magnesia** or **magnesium sulphate** is desirable.

Further treatment will be directed by the symptoms present; **stimulants** and **anodynes** are usually indicated in these cases.

To counteract acidosis, **sodium bicarbonate** may be administered.

Phosphorus coming in contact with the skin fumes or blazes and produces intense and more or less widespread destruction. This accident may occur especially in industrial plants and in troop maneuvers. If the patient is immersed in water, the blazing is resumed on emerging from the bath; ordinary oxidizing agents seem to act too slowly. The writer has found that a 1 per cent. solution of **copper sulphate** applied upon a gauze pad immediately arrests the fuming or blazing, leaving in its place a heavy black film of copper phosphide. Such an application is effective in $\frac{1}{2}$ minute. Large pads of absorbent cotton should be kept on hand along with the copper sulphate solution so that they can be instantly applied, after which the extinguished phosphorus can be removed mechanically and the skin treated as is usual in burns. D. C. Walton (Jour. Amer. Med. Assoc., May 23, 1925).

In chronic poisoning immediate **withdrawal from the harmful atmosphere** is demanded. The **teeth and gums** of the workers should be **carefully looked after**.

THERAPEUTICS.—During medication by phosphorus, the patient should be watched for the first symptoms of overeffect. The drug should never be given in large doses, and is not indicated where there are acute or inflammatory lesions. It should be given in the form of an alcoholic or oily solution.

In **rachitis** and **osteomalacia** phosphorus is perhaps best combined with codliver oil or lipanin (a mixture devised by von Mering as a substitute for codliver oil, consisting of 6 parts of oleic acid to each 100 parts of olive oil, and being free from disagreeable odor and taste, readily emulsified and easily digested), *e.g.*, phosphorated oil, 16 minims (0.5 c.c.); codliver oil, 4 ounces (125 c.c.). A teaspoonful (4 c.c.) four times daily. Kassowitz suggests: Phosphorus, $\frac{1}{6}$ grain (0.01 Gm.); saccharin, 72 grains (4.8 Gm.); essence of lemon, 2 minims (0.13 c.c.); codliver oil, $3\frac{1}{2}$ ounces (110 c.c.). A teaspoonful three times daily. J. Comby gives the following modification of Trousseau's formula: Phosphorus, $\frac{1}{7}$ grain (0.009 Gm.); potassium iodide, 4 grains (0.26 Gm.); potassium bromide, 15 grains (1 Gm.); table salt, 2 drams (8 Gm.); fresh butter, $17\frac{1}{2}$ ounces (550 Gm.). Of this mixture about $\frac{1}{3}$ ounce (10 Gm.) is given daily, spread upon bread.

Phosphorus has been regarded as a useful tonic and restorative in **neurasthenia**, or **nervous debility**, when the system is weakened by **anxiety**, **overwork**, or **sexual excesses**. It is also said to be useful in the **neuralgia**

of the **asthenic type**, but has little influence over pain. It has been given with asserted good effect in **herpes zoster** and in the weakened conditions following **acute and chronic alcoholism** and **morphinomania**, and likewise in **cerebral debility** and **mental enfeeblement**, even if symptomatic of **organic brain-lesion**.

It has also been recommended in **insomnia** due to cerebral anemia and malnutrition, in **functional impotence** or **sexual exhaustion**, and in **tabes dorsalis**.

In **anemia**, small doses of phosphorus, in conjunction with iron, are said to yield good results.

Phosphorus may be used as a restorative after **typhoid fever**, especially if the nervous system be particularly affected in prolonged cases; it is stated to hasten convalescence. Phosphorated oil is deemed valuable at times in **chronic malaria**. It has been used in the eruptive fevers (**measles**, **scarlatina**, etc.) when the rash recedes or does not come out promptly. In the third stage of **pneumonia** it is said to aid resolution.

In **lupus erythematosus**, L. D. Bulkley, of New York, has found phosphorus very useful. He uses Thompson's solution—liquor phosphori (Thompson), N. F.—as it causes less gastric and hepatic disturbance than the oily solutions or pills. He begins with 15 drops of the solution, quickly added to water and quickly taken, after meals thrice daily. The dose is gradually increased until 40 to 45 drops are taken; exceptionally, the dose may be increased to 60 drops. If gastric disturbance appear, it should be attended to and the drug stopped. If constipation be present, a pill of blue

mass, colocynth, and ipecac is indicated. When the gastric functions are restored, the use of phosphorus should be resumed. The treatment may be continued, with careful watching, for months, in this malady, and great benefit may be expected.

Hyperidrosis due to nervous debility may be checked by phosphorus.

C. SUMNER WITHERSTINE,
Philadelphia.

PHOSPHORUS NECROSIS.

See MOUTH, LIPS, AND JAWS, DISEASES OF.

PHTHISIS. See TUBERCULOSIS, PULMONARY.

PHYSOSTIGMA AND PHYSOSTIGMINE. — Physostigma, the Calabar bean, or the Ordeal bean of old Calabar, is the seed of *Physostigma venenosum*, fam. Leguminosæ, a woody creeper indigenous to western Africa along the River Niger and also found in India and Brazil. It resembles the scarlet runner and lima bean, bearing pendulous racemes of handsome, dark-purple, bean-like flowers and short, broad, 2- to 3- seeded pods. It contains at least 4 alkaloids: Physostigmine (eserine), eseridine, eseramine, and calabarine; and phytosterin (a substance related to cholesterolin), starchy matters, oils, etc.

Physostigmine occurs in colorless, very hygroscopic, thin, rhomboidal lamellæ, which gradually assume a rose tint and even a yellow color, especially on exposure to the air, and are readily altered to a resin-like mass. It is soluble in alcohol, ether, benzene, carbon disulphide, and chloroform, and sparingly soluble in water. The alkaloid is readily decomposed. Its watery solution soon becomes

red, especially when heated, and when evaporated leaves a cherry-red, amorphous residue which is insoluble in ether, but soluble in chloroform, and is called rubreserine. The same change takes place in solutions of salts of physostigmine. It forms salts with the acids, which vary in solubility; the salicylate alone is official.

Physostigmine salicylate occurs in colorless or slightly yellowish, lustrous crystals, soluble in 75 parts of water. This salt is least affected by the light, but must be kept dry. Solutions of this salt deteriorate on standing and become brownish-red in color, when they are spoiled for use; when freshly made, they are of a faint pink color.

Physostigmine sulphate occurs as a white or slightly yellowish, deliquescent, crystalline powder, of bitter taste. It is freely soluble in water and alcohol. This salt should be kept dry and away from the light.

Eseridine occurs in white, four-sided crystals, soluble in alcohol, ether, and chloroform. Eseridine is also a laxative and motor excitant, but is only one-sixth as powerful as physostigmine.

Eseramine occurs as crystals and is lacking in physiological effects.

Calabarine is a liquid, soluble in alcohol and water, but not in ether. In some respects it acts antagonistically to physostigmine and more like strychnine.

PREPARATIONS AND DOSES.

—*Physostigminæ salicylas*, U. S. P. (physostigmine salicylate). Dose, $\frac{1}{100}$ to $\frac{1}{30}$ grain (0.0006 to 0.002 Gm.).

Physostigma, U. S. P. IX (Calabar bean. Should contain not less than

0.15 per cent. of alkaloids soluble in ether). Dose, $\frac{1}{2}$ to 2 grains (0.03 to 0.13 Gm.).

Extractum physostigmatis, U. S. P. IX (alcoholic extract of physostigma, powdered; alkaloids, 2 per cent.). Dose, $\frac{1}{10}$ to $\frac{1}{2}$ grain (0.006 to 0.03 Gm.).

Tinctura physostigmatis, U. S. P. IX (tincture of physostigma, 10 per cent.). Dose, 15 minims (1 c.c.).

Physostigminæ sulphas, U. S. P. VIII (physostigmine sulphate). Dose, $\frac{1}{100}$ to $\frac{1}{30}$ grain (0.0006 to 0.002 Gm.).

PHYSIOLOGICAL ACTION.—

The physiological action of Calabar bean has been studied by a large number of observers, a summary of whose labors tends to demonstrate that the main effect of the drug on the nervous system is to depress the motor centers of the spinal cord. This action involves depression of the respiratory centers of the medulla, and, by reflex action, an increasing paralysis leading to paralytic asphyxia. The cerebral cortex, the sensory nerves, and the sensory nerve-centers suffer no loss of function, while the motor nerve-trunks are scarcely involved under normal circumstances. Poisonous doses, however, may cause all these structures to be more or less affected. Wood concluded that "Calabar bean acts directly either upon the muscle-structure itself or upon the peripheral nerve-endings in the muscles, producing contraction and not paralysis. The influence of the drug upon the circulation is entirely subordinate and is not at present completely understood. Early in the poisoning there is a rise of the blood-pressure, which is, in great part, if

not altogether, due to a direct stimulation of the cardiac muscle and its contained ganglia, and a slowing of the pulse also resulting from the direct action of the drug on the heart muscle. The precise action of the drug upon the vasomotor centers remains at present in doubt."

Physostigma increases peristaltic action, acts as a powerful stimulant upon the unstriated muscular fibers of the stomach and bowels, and increases their various secretions. Traversa found that physostigmine not only exaggerates the peristaltic movements, but also causes a violent and generalized contraction of the intestine and, finally, tetanus and contractures. If the contraction predominates in the longitudinal fibers, the intestine becomes wrinkled; if in the circular, it is beaded, ringed, or, if the contraction is violent and diffuse, ribbon-like. The higher nerve-centers (the vagus, spinal cord, and abdominal sympathetic ganglia) have no influence upon the production of these phenomena. A loop of intestine detached from the body and kept alive by artificial circulation gave the same reaction to physostigmine as intestines in the living body.

This indicates that the changes in motor activity do not depend upon the modification of the intestinal circulation.

Physostigmine produces exaggerated peristalsis and quite violent and diffuse contractions of the intestine solely by excitation of the peripheral motor apparatus. Traversa further calls attention to the fact that, so far as the intestine is concerned, the action of physostigmine is identical in intensity, and in duration as well, of effect with pilocarpine,

not only nosographically, but mechanically.

In the eye physostigmine causes contraction of the pupil (myosis) by stimulating the motor oculi nerves peripherally, and diminished intra-ocular tension.

Given in small doses ($\frac{1}{100}$ grain or less—0.0006 Gm.) physostigmine acts as a stimulant, causing muscular twitching with increased irritability and tonus of the muscular fibers. The pulse is slowed and vascular tension is increased; the respirations are stronger and accelerated. The principal effect is on the musculature of the stomach, intestines, bladder, ureter, uterus, and bronchi, all of which are strongly stimulated. The saliva, perspiration, tears, mucus, and pancreatic juice are augmented. The pupil is contracted, but accommodation for near vision is not lost.

The temperature is little affected, if at all.

POISONING BY PHYSOSTIGMA.—In toxic doses physostigma is a powerful poison, producing extreme muscular debility, vomiting (may be absent), abdominal pain, dyspnea, and giddiness, followed by paralysis of the voluntary muscles, convulsive muscular twitchings, and invariably a contraction of the pupil. When taken by the mouth physostigmine causes paresis of the pharyngeal constrictors by a local action which Harnack considers a direct action on the secretory gland cells and the muscular fibers; others claim that the effect is due to an action on the peripheral nerve-endings. The respirations become slow and irregular, the pulse slower and weak, vascular tension falls, and there is an abolition of all the reflexes. The

temperature, especially that of the surface, is somewhat lower. Death may occur from cardiac syncope, or, if taken in smaller quantity, from paralysis of the respiratory center and asphyxia. The action on the heart is a direct one on the heart muscle and is not from stimulating inhibition. The mind is usually clear to the end. Death has occurred from 19 beans in the adult, 6 beans in a boy, and an extreme degree of collapse resulted from the hypodermic injection of $\frac{1}{20}$ grain (0.003 Gm.) of physostigmine into a child 9 years of age: profuse diaphoresis, vomiting, and collapse, with pulse 54, and scarcely perceptible and greatly diminished pupillary reflex (Lodderstädt). Marked sedation approaching collapse has followed single hypodermic doses of $\frac{1}{50}$ grain (0.0013 Gm.) (W. C. Abbott). The voluntary muscles are markedly weakened, but the involuntary muscular fibers and secretions are stimulated.

Treatment of Poisoning by Physostigma.—If the crude drug (powdered beans) or extract have been swallowed, **evacuation** (by **emetic** or **stomach-tube**) and **lavage of the stomach**, are indicated. To antidote the residual poison give **tannin**, 30 grains (2 Gm.) in 3 to 4 ounces (90 to 120 c.c.) of water, or give large doses of **strong tea**. To eliminate the poison from the system give 1 dram (4 c.c.) of **spirit of nitrous ether**; use **catheter** if necessary. As physiological antitodes give **atropine** hypodermically, 1 or 2 minims (0.06 or 0.12 c.c.) of a 1 per cent. solution, until pupils dilate; **strychnine nitrate** hypodermically, $\frac{1}{2}$ grain (0.005 Gm.), or **hydrated chloral**, 10 grains

(0.6 Gm.) every fifteen minutes. As stimulants, liberal amounts of **strong coffee; brandy**, 2 to 4 drams (8 to 15 c.c.), and **aromatic spirit of ammonia**, $\frac{1}{2}$ to 1 dram (2 to 4 c.c.). Application of **external heat** to the body is advisable, and if breathing is impeded **artificial respiration** is indicated.

THERAPEUTICS.—Physostigmine has been considered a useful remedy in various **spasmodic disorders**. In **tetanus** recovery was stated to have followed its use in more than 50 per cent. of the cases reported by Fraser and Shoemaker, who recommended it to be given until decided physiological effects were produced. Fraser advised 1 grain (0.06 Gm.) of a good extract by the mouth, repeated every two hours, and increased or diminished according to the effect produced. In other nerve affections some improvement has been claimed, especially in **chorea, epilepsy, trismus neonatorum, and infantile convulsions**. It has also been used in convulsive disorders of individual muscles (**tic, twitching of the orbicularis, histrionic spasm, etc.**), and in **writers' cramp**. Much more effective remedies, however, are now available for most of these conditions.

More recently, physostigmine has been used by some observers in different states of excessive irritability of the heart, in order to overcome the resulting arrhythmias by stimulating the peripheral vagal structures; likewise, to antagonize overactivity of the sympathetic portion of the vegetative nervous system by stimulating the parasympathetic.

Physostigmine deemed clinically serviceable as a remedy for **sympathetico-tonia** and certain attendant symptoms. The writer found it effectual in **tachycardia, epigastric palpitation, discomfort after meals, vertigo**, some cases of

migraine or high blood-pressure and, in particular, in "**solar plexus crises**." He uses a mixture of 0.01 Gm. ($\frac{1}{100}$ grain) of neutral physostigmine salicylate, 3.5 c.c. (56 minims) of glycerin, 1.5 c.c. (24 minims) of distilled water, and alcohol, to make 10 c.c. (2 $\frac{1}{2}$ drams). From 30 to 80 or 100 drops a day of this solution, of which 50 drops contain 1 mgm. ($\frac{1}{60}$ grain) of the alkaloid, are taken by mouth, before meals. No cumulative action was observed, even after months. Evidences of incipient toxic action were seen only in 3 or 4 instances, consisting of lassitude, a feeling of stiffness in the back and neck, weakness, dizziness, and slight nausea. Moutier (Paris méd., Dec. 3, 1921).

Physostigmine sulphate proved useful when given, sometimes by mouth in daily amounts of 1 to 1.5 mgm. ($\frac{1}{60}$ to $\frac{1}{40}$ grain), at others intravenously in doses of 0.5 to 1 mgm. ($\frac{1}{120}$ to $\frac{1}{60}$ grain) in 2 c.c. (32 minims) of water, in **tachycardia** and **auricular fibrillation**. In **sino-auricular paroxysmal tachycardia** it acted well in combination with strophanthus. Its use is advocated in cases of fibrillation refractory to quinidine. De Meyer (Arch. des mal. du cœur, Nov., 1922).

Physostigmine is an efficient remedy in **atony of the intestines**. Hare and others have commended its use in **gastric and intestinal dilatation**, combined with *nux vomica*. In purgative pills it is useful to stimulate the muscular fibers of the intestines. In **atonic constipation** with defective secretion the following is useful: Extract of physostigma, 3 grains (0.2 Gm.); extract of belladonna, 1 grain (0.06 Gm.); resin of podophyllum, 3 grains (0.2 Gm.); oil of cajuput, 4 minims (0.25 c.c.). To be made into 12 pills; 1 or 2 to be taken at night.

Physostigmine will prevent or overcome **postoperative intestinal atony**, and may prevent the formation of **intestinal adhesions** (Vogel); for these pur-

poses a dose of from $\frac{1}{120}$ to $\frac{1}{60}$ grain (0.0005 to 0.001 Gm.) is given hypodermically, and is repeated after several hours if necessary. The action of the drug can be promoted by giving a small enema of glycerin, which affects the lower bowel alone.

Physostigma has been used successfully in **atony of the bladder** and in **vesical debility**. In these cases physostigmine strengthens the detrusor alone, having no effect on the sphincter. Giovanni, of Turin, has obtained good results from this drug in cases of **renal hemorrhage**. He combines it with ergotin: Extract of physostigma, 6 grains (0.4 Gm.); ergotin, 30 grains (2 Gm.); extract of gentian, a sufficient quantity. This makes 20 pills, 1 or 2 of which are taken daily, increased daily until effectual or the limit of tolerance is reached.

Physostigmine is a physiological antidote in **poisoning by atropine** and **by chloral**. With the bromides it may be found useful in **poisoning by strychnine**.

Waugh has found physostigmine useful in the treatment of the **morphine habit** in cases where the pupil is dilated after the morphine has been stopped, but only then; the physostigmine replaces the morphine so completely that the substitution is not detected by the patient. The dose should not exceed $\frac{1}{100}$ grain (0.0006 Gm.) twice daily. The relief lasts not more than an hour after each dose, but is absolute.

The physostigmine salts are used extensively in ophthalmic practice on account of their myotic power and their power to relieve **high intra-ocular tension**. It is not well borne in acute inflammation, or if much

ciliary congestion is present (M. L. Foster). It is positively contraindicated in the acute stage of iritis, but is used by some oculists to break up **iritic adhesions** after the subsidence of the **acute symptoms**. According to some observers, it has a tendency to increase opacities of the crystalline lens; this should be borne in mind in connection with cases of incipient cataract. In **corneal ulcerations** it is preferable to atropine, and its use may prevent **prolapse of the iris** after **wound or ulceration of the cornea**.

In the treatment of **glaucoma** this drug is generally satisfactory. A solution of physostigmine salicylate $\frac{1}{2}$ to 1 grain—0.03 to 0.06 Gm.—to 1 ounce—30 c.c.—of recently boiled water) instilled into the eye two to five times daily will reduce the tension and pain very decidedly. In some cases prolonged treatment results in permanent cure without iridectomy; in others the tension returns in a few hours after its discontinuance. In **phlyctenular keratitis** it is useful in diminishing photophobia. Cameron has used this drug successfully in **paralytic mydriasis following diphtheria**. Instillations of physostigmine salicylate solution may be used to rapidly overcome **atropine mydriasis** when desired; as the action of atropine is the more persistent, it may return as the effects of the physostigmine wear off, and necessitate a repeated use of the latter. The solutions used in ophthalmological work generally vary in strength from $\frac{1}{2}$ to 2 grains (0.03 to 0.13 Gm.) of physostigmine salicylate to the ounce (30 c.c.) of recently boiled water.

C. SUMNER WITHERSTINE,
Philadelphia.

PICRIC ACID.—Picric acid (trinitrophenol; picronic, picrinic, carbazotic, nitroanthic, or nitrophenic acid) is obtained from phenol (carbolic acid) by nitration. It occurs in yellowish, lustrous, flat crystals, without odor, but of an intensely bitter taste. It is readily soluble in alcohol, ether, chloroform, benzene, petroleum benzin, and slightly soluble in water (in 86 parts at 59° F.—15° C., and in 25 parts of boiling water). It is an antiseptic and an oxidizing substance.

PHYSIOLOGICAL ACTION.—The main action of picric acid seems to be exercised upon the blood, that of rabbits slowly poisoned by it having been found by Erb to assume a dirty, brownish hue. Distinct nuclei were found floating in the serum in their free state, and in the red corpuscles, while the white corpuscles were markedly increased in number. It causes distinct jaundice in man, in suitable doses, the skin, conjunctivæ, and urine being colored reddish yellow. Poisonous doses cause hypothermia, diarrhea, collapse and death.

THERAPEUTICS.—Picric acid was formerly used internally in malarial diseases, in trichiniasis, and as an anthelmintic and tonic. Experience has shown that it possesses little or no action in these conditions. In doses larger than 5 grains it is poisonous (antidote: albumin).

It is chiefly used after the method of the French surgeons, Thierry and Filleul, for the treatment of **burns** and **scalds**. In solution (1:200) it is analgesic, antiseptic, and keratogenous, and its use is free from the accidents sometimes provoked by antiseptics, as it is not irritant, caustic, or toxic. Filleul advises the use of a solution obtained by adding the crystals to boiling water, the excess being removed by decanting. The golden-yellow solution thus obtained is left to cool in a vessel stoppered with cotton to insure asepsis. After cleansing the burn and pricking all blisters, compresses of tarlatan previously boiled to remove the stiffness, or plain aseptic cheese-cloth or gauze, are dipped into boiling water, then into the solution, wrung out, and applied in several thicknesses over the burning area. Over this may be placed a layer of dry absorbent cotton, fastened in place by a roller band-

age lightly applied. The dressing dries rapidly and may be left in place several days. For removal it is moistened with the solution so as to soften it. A fresh dressing is applied and left for a week. This application relieves all pain, inhibits suppuration, and leaves a smooth cicatrix.

Hare suggests the following solution: Picric acid, 75 grains; alcohol, 2½ ounces; distilled water, 2 pints. Mix. (See BURNS, TREATMENT.)

Fortunati warmly recommends picric acid for treating **burns** of the **conjunctiva** and **cornea**, especially when caused by chemical agents, including lime. He finds that a 2 per cent. ointment made with neutral petroleum album as a base is better than a watery solution. The ointment is applied two or three times a day after the instillation of a few drops of cocaine solution. Symblepharon is rare after this treatment.

Mitchell recommends a 1 per cent. alcoholic solution of picric acid for **skin disinfection**, because it is not only germicidal, but because of its great penetrating power.

Picric acid has been employed by Chéron as a caustic and antiseptic after curetting the uterus for **fungous endometritis**; he used a watery solution (1:300). In a weaker watery solution (1:1000) it has been used in **eczema**, **erysipelas**, **lymphangitis**, **fissured nipples**, and in **impetiginous eczema**, after removing the crusts with oil.

Acute eczema is rapidly relieved under the influence of picric acid. Applied as a pigment with a brush or piece of absorbent wool, even to an extensive surface, it is quite free from danger, and causes not the slightest pain, however vascular the surface may be.

A solution of 3 drams (12 Gm.) of picric acid in one quart (1 liter) of tepid boiling water is painted over and somewhat beyond the affected surfaces; the parts are then wrapped in lint wrung out of the same solution, and over this is placed a covering of cotton-wool. Oiled silk should not be used. The dressing should be renewed every two or three days. In chronic eczema the results are not so favorable.

Picric acid has been used in watery solution (15 grains to 1 ounce) as a **test for**

albumin in urine. Though delicate, it is unreliable, as it also precipitates mucin, peptones, and potassium salts. It has also been used for the **detection of sugar** in urine, but is inferior to other well-known tests.

In pathological and histological work picric acid is used for **staining and fixing specimens**. In combination it is also used for the **decalcification of bones and teeth**.

W.

PICROTOXIN, or cocculin, is the neutral principle from the seed of *Anamirta paniculata* (cocculus indicus, Indian berry, fishberry). Picrotoxin ($C_{45}H_{50}O_{18}$) is found in the seed associated with picrotin and anamirtin. It occurs as colorless, odorless, prismatic crystals, having a very bitter taste, and is soluble in alkalis and acids, in 13 parts alcohol, and in 330 parts water.

PREPARATION AND DOSE.—While official in the B. P. as Picrotoxinum, picrotoxin is not recognized in the U. S. P. Dose, $\frac{1}{100}$ to $\frac{1}{30}$ grain (0.0006 to 0.002 Gm.): It has been used in an unofficial ointment ($\frac{1}{2}$ to 1 per cent.) for external medication. Cocculus indicus (the berries), though not official, is used externally in the form of a tincture (25 per cent.), decoction (1:16) and ointment (1:8).

PHYSIOLOGICAL ACTION.—Picrotoxin, when taken internally in medicinal doses, causes an elevation of the body temperature, and in large doses produces salivation and vomiting. This drug stimulates the origins of the inhibitory fibers of the vagus, the vascular and respiratory centers, and the motor areas of the medulla. It possesses an anhidrotic action very similar to that of pilocarpine and muscarine, and is antagonized by atropine and its congeners.

Picrotoxin causes a slowing of the pulse, by stimulating the cardiac inhibitory centers in the medulla and by its direct depressing effect on the heart muscle. The arterial pressure is increased.

Large doses cause stupor and epileptiform convulsions, the latter occurring as marked clonic movements following a period of tonic muscular contraction, and being due to irritation of the motor cells in the medulla and spinal cord.

The respirations are at first accelerated, but during the spasms the breathing is interrupted; during the intervals of quiet and collapse following, the breathing is resumed. The respiratory depression, however, increases until the breathing fails to be resumed after a spasm, and death from asphyxia results.

POISONING BY PICROTOXIN.—

Picrotoxin and cocculus indicus are very poisonous to the lower forms of life, and to many act as acrid, narcotic poisons. In the lower animals convulsions precede death. Poisoning may follow its external use or from swallowing a toxic dose of the drug. A fatal case is cited by J. V. Shoemaker where a child, 6 years old, was poisoned by the absorption of a strong alcoholic solution of the berries used on the scalp, in whom tetanic convulsions occurred. The convulsions are, however, usually of the epileptiform type. As a possible source of poisoning, we must bear in mind that cocculus is sometimes added to malt liquors to save hops and check fermentation. This may be an active element in drunkenness from the use of malt liquors and explains why intoxication should be viewed as a condition of poisoning demanding prompt and intelligent treatment.

Treatment of Poisoning.—This condition should be met with the use of **emetics and siphonage of the stomach**. **Tannin, chloral**, and the **bromides** are the most efficient antidotes, and should be used in connection with **inhalations of ether or ammonia**, and the internal or hypodermic administration of **stimulants**. The antagonism between chloral and picrotoxin is without question and can be utilized even when the poisoning has occurred from absorption through the integument.

THERAPEUTIC USES.—Fishberry, or cocculus indicus, is used against **phtheiri-asis (lousiness)**, but care must be taken, especially in children or when abrasions of the scalp exist, not to use strong solutions, nor to leave them too long in contact with the skin. One part of cocculus tincture to 8 parts water, or a decoction (1:16) may be applied to the scalp, after thorough cleansing, left on a few minutes and then well washed off

with warm water. Two or 3 daily applications are usually sufficient. An ointment of picrotoxin (2 per cent.) has been used, but is not safe. A weak ointment ($\frac{1}{2}$ to 1 per cent.) combined with ointment of mercuric oleate is valuable in animal and vegetable parasitic diseases, as **scabies**, **pediculosis**, **trichophytosis**, and **tinea versicolor**.

In small doses it may be of service in **gastric atony**, **intestinal indigestion**, **flatulence**, **colic**, **painful dyspepsia**, and **deficient metabolism**.

Its use in **epilepsy**, **chorea**, and **paralysis** has only in part met the claims made by Planat and Hammond, Gubler, Phillips and others. As an anhidrotic it has proved its value in the **night-sweats of phthisis**, and in other forms of **hyperidrosis**.

Bókai suggests picrotoxin as an antidote in **opium poisoning**, by reason of its stimulating action upon the respiratory and vasomotor centers. It may, for the same reason, be used in **chloral poisoning** and in **poisoning by strophanthus**. W.

PIEDRA.—Piedra, or trichosporosis tropica, first scientifically described by Desenne in 1878, is a mycotic disease found in parts of South America, causing small, very hard nodosities on the hair. This disease of the hair is common in some parts of Colombia, especially in the valley of Canca, but allied conditions are observed in India and Ceylon, and occasionally in temperate zones (*piedra nostras*).

SYMPTOMS.—In women the hair of the head—and, less frequently, the hair of the head and beard of men—is affected. The affected hairs are the seat of strings of pinhead nodosities, easier felt than seen. These nodosities are located on the surface of the hair shaft, on one side alone or inclosing it. They may be very numerous, are black and hard, though not so hard as the name *piedra* (stone) would suggest. A peculiar crepitation is produced when the hair is combed. Matting and knotting of the hair is not infrequent. The disease is chronic and does not disappear spontaneously.

DIAGNOSIS.—The diagnosis is made by the microscopic examination of the nodosities.

ETIOLOGY AND PATHOLOGY.—

In trichosporosis tropica, if an affected hair is washed in ether, and then treated with liquor potassæ, and then examined microscopically, we find the nodule to consist of large polyhedric refringent bodies held together by an amorphous substance acting as a cement (Castellani). These bodies are the spores of the pathogenic fungus (*Trichosporum giganteum*, Behrend, 1890).

In trichosporosis Indica (India and Ceylon) the fungus is somewhat different, the disease less severe, a few nodules only being found on the hairs of the beard, the scalp usually escaping.

In trichosporosis of temperate zones (*piedra nostras* or *tinea nodosa*) the nodosities have been found on the hairs of the beard, not on the hairs of the head (Beigel, 1869). The fungi differ slightly from *T. giganteum*. Several species have been described.

PROGNOSIS.—The disease lasts long. There is no spontaneous cure.

TREATMENT.—Treatment has been unsatisfactory. Castellani advises the application of **benzene** and **turpentine** to the hair and regular washing of the head with a 1:2000 **bichloride solution**. It may be necessary to **shave the head**. W.

PILES. See HEMORRHOIDS.

PILOCARPUS AND PILOCARPINE.—

Pilocarpus, or *jaborandi*, consists of the dried leaflets of the South American trees *Pilocarpus jaborandi* and *Pilocarpus microphyllus*, belonging to the family Rutaceæ. The leaflets are oblong to obovate in shape, thick and smooth, and possess an aromatic odor and an aromatic, bitter, and pungent taste. When chewed they produce an increased flow of saliva. The leaflets of the *jaborandi* species, which of late years has become very scarce, are much larger than those of the *microphyllus* variety. *Pilocarpus* contains the alkaloids *pilocarpine*, *isopilocarpine*, and *pilocarpidine*, having similar actions,

but markedly unequal in power, pilocarpine being the strongest and pilocarpidine the weakest. These alkaloids, in the uncombined state, are all syrupy or oily liquids. They form crystalline salts. Fresh pilocarpus contains also a volatile oil and a stearoptene or camphor-like body belonging to the olefine series.

PREPARATIONS AND DOSE.—

Pilocarpina hydrochloridum, U. S. P. (pilocarpine hydrochloride) [$C_{11}H_{16}N_2O_2 \cdot HCl$], occurring in colorless or white crystals, odorless, having a faintly bitter taste, and highly deliquescent on exposure to the air. One Gm. of it is soluble in 0.3 c.c. of water, 3 c.c. of alcohol, and 366 c.c. of chloroform, at 25° C. Dose, $\frac{1}{20}$ to $\frac{1}{4}$ grain (0.003 to 0.015 Gm.); official average dose, $\frac{1}{12}$ grain (0.005 Gm.).

Pilocarpina nitras, U. S. P. (pilocarpine nitrate) [$C_{11}H_{16}N_2O_2 \cdot HNO_3$], occurring in colorless or white, shining crystals, odorless, with a faintly bitter taste, and presenting the advantage over the hydrochloride of being permanent in the air. One Gm. of it is soluble in 4 c.c. of water, in 75 c.c. of alcohol at 25° C., and in 21 c.c. of alcohol at 60° C. It is insoluble in chloroform. Dose, $\frac{1}{20}$ to $\frac{1}{4}$ grain (0.003 to 0.015 Gm.); official average dose, $\frac{1}{12}$ grain (0.005 Gm.).

Pilocarpus, U. S. P. IX (pilocarpus; jaborandi), required to contain not less than 0.5 per cent. of alkaloids. Dose, 5 to 50 grains (0.3 to 3.3 Gm.); average, 30 grains (2 Gm.), containing about $\frac{1}{4}$ grain (0.01 Gm.) of alkaloids.

Fluidextractum pilocarpi, U. S. P. IX (fluidextract of pilocarpus or jaborandi), so prepared and assayed as to contain 0.6 per cent. of the pilocarpus

alkaloids. Dose, 10 to 60 minims (0.6 to 4 c.c.); average, 30 minims (2 c.c.), containing about $\frac{1}{8}$ grain (0.008 Gm.) of alkaloids.

Elixir pilocarpi, N. F. III (elixir of pilocarpus), every 2 fluidrams (8 c.c.) of which represents $7\frac{1}{2}$ grains (0.5 Gm.) of pilocarpus. Dose, 2 to 4 fluidrams (8 to 16 c.c.).

MODES OF ADMINISTRATION.—The drug is generally used in the form of subcutaneous injections of the pilocarpine salts, the latter being preferable to the crude pilocarpus in that nausea and vomiting are less often caused. For instillation in the eyes, 2-grain (0.12 Gm.) to the ounce (30 c.c.) or 1:200 solutions are generally employed. Externally, as an addition to hair washes, the fluidextract of pilocarpus is sometimes used, being less expensive than the alkaloid.

Internally, the action of pilocarpine is uncertain and slow in comparison with its effects when administered by hypodermic injection; it seems that quite alarming cardiac depression may be thus brought on without any previous perceptible diaphoresis (Willoughby).

In administering a pilocarpine "sweat," the patient must be put to bed. His nightshirt should be removed and he should be wrapped closely in a very warm, dry blanket, over which two other blankets should be thrown and tucked in all round the bed. Hot-water bottles, encased in flannel, should be put to his feet, and hot drinks may be given by the mouth freely. The pilocarpine is then to be administered hypodermically, the amount given being usually about $\frac{1}{8}$ grain (0.01 Gm.). The strength of the solution used varies: (1) 1 grain (0.065 Gm.) of pilocarpine nitrate in 20 minims (1.3 c.c.) of distilled water, the dose

being 2 to 6 minims (0.13 to 0.39 c.c.); or (2) 1 grain (0.065 Gm.) in 12 minims (0.78 c.c.), with a dosage of 1 to 4 minims (0.06 to 0.26 c.c.). Profuse sweating should begin within half an hour, and may continue for from half an hour to two hours. If free perspiration does not come on, it is advisable to give the patient a tumblerful of cold water to drink slowly; the vasoconstriction that results in the splanchnic area serves to drive more blood to the surface of the body and thereby facilitates sweating.

After sweating has ceased, but not before, the blankets should be removed gradually, the skin rapidly but thoroughly dried, and the patient left between fresh, warm, dry blankets. (The Hospital, June 22, 1907.)

INCOMPATIBILITIES.—Pilocarpine salts in solution are incompatible with alkalis, iodides, potassium permanganate, and salts of the heavy metals, such as mercury, silver, and gold.

CONTRAINDICATIONS.—Pilocarpine should not be employed internally, or given in full dosage by hypodermic injection, where the heart is weak or there is a tendency to pulmonary congestion and edema. In comatose patients the use of pilocarpine is attended with some danger, owing to the increase of salivary and bronchial secretions it causes, which, in a patient whose reflexes are obtunded, may lead to serious interference with the respiratory and cardiac functions.

PHYSIOLOGICAL ACTION.—

Externally, pilocarpine exerts no action, except possibly a stimulation of the hair-follicles, which has been ascribed, in turn, to excitation of the glands of the scalp, with consequent better local circulation and improved nutrition to the follicles.

General Effects.—*Nervous System.*

—On the nerve-centers of the brain, pilocarpine has but little effect. Even in poisoning, the mind remains clear. The spinal cord and medulla are, however, depressed by large doses. Peripherally, pilocarpine powerfully stimulates the endings of the nerves constituting the so-called "autonomic" or vagosacral system.

Circulation.—Pilocarpine is typically a depressant to the heart, slowing its rate, in large doses, through stimulation of the cardioinhibitory vagus nerve-terminals. A moderate fall in the blood-pressure may occur in consequence. In some instances, however, the drug, at least at first, accelerates the heart slightly—through depression of the vagus centers—and raises the blood-pressure. After toxic doses of pilocarpine the heart muscle is itself directly depressed and at the same time the vessels become dilated through depression of the vasoconstrictor center in the medulla, a fall in blood-pressure therefore occurring.

The leucocyte count of the blood, as well as its sugar content, are increased by pilocarpine.

Intravenous injections of pilocarpine nitrate in the dog produce a rapid increase in the output of lymphocytes through the thoracic duct. The lymphocytosis of the blood is probably the result of this increased output. The true cause of the quickened lymph flow is not clear, but it may result from contraction of smooth muscles. Rous (Jour. of Exper. Med., May, 1908).

Respiration.—This is unaffected by ordinary doses of pilocarpine. Excessive amounts not only depress the respiratory centers, but bring about increased bronchial secretion and a

contraction of the involuntary muscle-tissue in the bronchial walls, thus tending to promote a condition of asthmatic respiratory embarrassment which, in conjunction with the frequently coexisting depression of the circulation, readily results in edema of the lungs and grave asphyxia.

Secretions.—Pilocarpine powerfully stimulates many of the secretions, in particular the sweat secretion, which may be so activated that from four to nine pounds of body weight is lost through the elimination of water by the skin after a single large dose. This sweating takes place even after the nerves of the glands have been sectioned, and is ascribed to excitation of the terminals of the nerves in the secreting cells, or of these cells themselves. The sebaceous glands are also stimulated, the sweat being therefore rendered acid or at least neutral in reaction owing to the fatty acids in the sebaceous secretion.

Among other secretions markedly increased by pilocarpine are the saliva and the bronchial mucus. The lachrymal secretion, the ear-wax, all mucous secretions, and the gastric, intestinal, and pancreatic secretions are also found to be more or less augmented.

Pilocarpine acts on both sections of the vegetative nervous system; it provokes increased salivary secretion through parasympathetic and sweating through sympathetic nerve-fibers. Sweating provoked by the injection of 0.01 Gm. ($\frac{1}{10}$ grain) of pilocarpine is no proof of parasympathetic innervation of the sweat glands. Parasympathetic irritability must be examined by injecting only 2 mgm. ($\frac{1}{32}$ grain) of pilocarpine; it is considered increased when this dose provokes 50 c.c. or more of salivary secretion. Escudero (*Endocrinol.*, Mar., 1923).

Prolongation of the evacuation time of the stomach was noted after pilocarpine injections. There was also increased gastric secretion, but of a less acid fluid. H. Kalk (*Arch. f. Verd.*, Feb., 1924).

The mammary, biliary and renal secretions are, on the other hand, not believed to be directly affected; the urinary output may, in fact, be considerably diminished owing to the pronounced loss of water through the skin. According to some, small doses of pilocarpine tend to increase urinary secretion. All the secretory effects of pilocarpine can be prevented or overcome by atropine.

Pilocarpine affects the output of urine both indirectly through loss of fluid from other glands and also, and probably to a greater extent, by its constricting action on the musculature of the ureters. D. Cow (*Proc. Royal Soc. of Med.*; *Med. Rec.*, March 22, 1913).

In 4 dogs 0.5 mgm. of atropine was sufficient to neutralize the effects of 5 mgm. of pilocarpine on the salivary secretion. The ratio of atropine to pilocarpine, in which they suffice to neutralize each other, was found to be constant in the series of animals. In the same dog the ratio of the pilocarpine to that of the atropine necessary to oppose its action remained the same however much the actual amounts injected might vary; the antagonism proceeded according to the laws of mass action, and not according to those of chemical combination. When one poison had been allowed to act for some time, its antagonist was less effective than if it had been injected simultaneously. A. R. Cushny (*Jour. of Pharm. and Exp. Ther.*, Mar., 1915).

The amount of sugar in the milk is increased by pilocarpine.

Muscular Tissues.—Stimulation of the nerve-endings in involuntary muscle-tissue analogous to the effect on the nerve-endings in glands takes

place under pilocarpine, but its effects are manifest only after larger doses, chiefly in the form of increased gastrointestinal motility together with contraction of the bronchi, bladder and pupils. The uterus and smooth muscle of the blood-vessels do not appear to be affected. The voluntary muscles are likewise uninfluenced.

Eyes.—Instilled in the eye, pilocarpine solutions cause (1) marked contraction of the pupil, reaching its height in one-half to one hour and subsiding after three or four hours; (2) stimulation of the ciliary muscle, with consequent spasm of accommodation and constant adjustment of the eye for near vision, and sometimes a dull pain due to the unusual activity of the ciliary muscle, and (3) a preliminary rise in intraocular tension, which may last half an hour and is believed to be due to increased secretion of the humors of the eye, followed by a more pronounced and characteristic fall in the pressure, ascribed to the broadening of the spaces of Fontana, or lymphatic outlets of the eye when the surrounding tissues are drawn apart through contraction of the iris. Effects (1) and (2) are due to stimulation of the endings of the oculomotor nerve in the constrictor muscle of the iris and the ciliary muscles, respectively.

Absorption and Elimination.—Pilocarpine is absorbed rather rapidly, and is eliminated in the urine, sweat, and saliva.

POISONING.—Serious and even fatal results have followed the injection of medicinal doses of pilocarpine; $\frac{1}{8}$ grain (0.02 Gm.) has been known to cause, in addition to profuse diaphoresis, salivation, lachrymation, a discharge from the nose, nausea,

dyspnea, and a sense of cardiac oppression. Rémy mentions a case in which the remedy induced a series of epileptic attacks. In another case the patient suddenly expired directly after an injection had been made.

Lethal doses are usually followed by copious sweating, flushed skin, dizziness, salivation and swelling of the salivary glands and tonsils, lachrymation, discharge from the nose, hiccough and strangling, nausea and abdominal cramps and vomiting, diarrhea, a tearing pain in the eyeballs, myopia, dimness of vision, strongly contracted pupils, prostration, dyspnea, cardiac oppression, and sometimes a bloody leucorrhœa. The circulatory condition is at first one of excessive vagus action and vasomotor depression, with consequent slow or even intermittent (heart-block) cardiac action and low blood-pressure, followed by direct cardiac impairment and the symptoms of collapse. The dyspnea is due to augmented bronchial mucous secretion or actual pulmonary edema, together with bronchoconstriction. Ascending motor paralysis may be observed, but consciousness is likely to remain until the exitus, which occurs typically from pulmonary edema. The occasional report of cases of accident following the administration of medicinal doses of pilocarpine imposes some degree of caution in the use of this remedy.

Case of extensive eruption following the prolonged use of pilocarpine. The patient, a man aged 52 years, had episcleritis and increased ocular tension, for which instillations of 0.05 per cent. solution of pilocarpine and hypodermic injections of 0.05 to 1 cgm. ($\frac{1}{120}$ to $\frac{1}{6}$ grain) of the same drug were prescribed. Under this

treatment the vision improved, but after 35 hypodermic injections and about 80 instillations an eruption appeared which occupied the face, the trunk, and the limbs, and was polymorphous, consisting of papules, vesicles, pustules, and impetiginous crusts; some of the lesions were umbilicated. Symptoms of systemic intoxication accompanied the eruption, and at the end of two months the patient died. Histological examination of the eruptive lesions revealed an inflammatory exudate about the excretory ducts of the sweat-glands. The eruption was unaccompanied by fever. Hallopeau and Viellard (*Annales de dermat. et de syphil.*, No. 3, 1904).

Treatment of Pilocarpine Poisoning.—**Atropine** should at once be given hypodermically in full doses— $\frac{1}{50}$ to $\frac{1}{15}$ grain (0.0012 to 0.004 Gm.), as physiological antidote. In its absence, any preparation of **belladonna** or other drug containing atropine, or even **scopolamine** (hyoscyne) in moderate dosage may be employed. Where **jaborandi** has been taken internally, the **stomach-tube** or an **emetic** should be used. The drug itself tends to produce vomiting which, if it persists unduly, may be combated with **morphine**.

In patients in whom symptoms of spinal or circulatory depression, such as motor paresis and collapse, are witnessed, stimulants such as **strychnine**, **caffeine** or hot, strong **coffee**, and **ammonia** preparations, should be freely used, together with **artificial respiration**. Partial **inversion** of the patient may be of service in freeing the bronchial tubes of excessive secretions and preventing descent of the latter into the pulmonary air spaces, with the consequent restriction of respiratory surface.

THERAPEUTICS.—As a **diaphoretic**, pilocarpine is generally to be preferred to **jaborandi**, as it is less likely to produce nausea and vomiting. In **chronic nephritis** and **uremia** pilocarpine injections may do much good through elimination of the excess of urea and related nitrogenous compounds with the sweat. A daily dose of $\frac{1}{4}$ grain (0.015 Gm.) of pilocarpine hydrochloride, or 10 minims (0.6 c.c.) of the fluidextract of pilocarpus three times daily may be administered with advantage (Tyson). In general, however, pilocarpine is considered of secondary importance to external applications of heat (sweat baths), owing to the greater likelihood of secondary depression and the possibility of its inducing pulmonary edema or impairing heart action. In **acute scarlatinal nephritis** pilocarpine has been used with benefit, though Griffith considers it dangerously depressant in children, and recommends it only for adults. In the **uremia of puerperal eclampsia** pilocarpine may be of marked benefit, but in some cases it does more harm than good by its depressing influence.

Jaborandi is capable of bringing about, upon continued use, favorable results in **nephritis**, **acute** as well as **chronic**. The usual dosage administered by the author was 20 minims (1.25 c.c.) of the fluidextract (sometimes combined with **nux vomica** and **digitalis**), to be taken every three hours until the skin and kidneys were acting well; then three doses daily.

In using the **jaborandi** continuously, the specific gravity of the urine would remain the same, or even be increased, as the secretion of urine increased. Casts became more numerous in the beginning of the treatment. After decided improve-

ment took place, the quantity of urine became less, until little more than the normal quantity was passed; then, as the quantity of urine decreased, the specific gravity returned to normal. The author feels confident that jaborandi must act in some special manner upon the kidneys, assisting nature to free the tubes when they are obstructed with epithelial or fibrous *débris*. A. P. Dearborn (Mass. Med. Jour., May, 1907).

Pilocarpine has been used in general **dropsy**, **ascites**, and **hydrothorax**. In dropsy of renal origin it is a valuable agent, but when the condition is due to cardiac trouble it is too depressing. In hydrothorax it is of considerable value, but thoracentesis is, perhaps, best, and elaterium or salines come next in efficiency.

Successful results have been reported from the use of pilocarpine in **acute erysipelas**. Da Costa recommends the hypodermic administration of $\frac{1}{6}$ grain (0.01 Gm.) every three hours until free sweating ensues, then every four to six hours. The diaphoresis is at once followed by retrocession of the rash and improvement in the general condition.

When dealing with atonic cases of erysipelas, when the heart is weak and perspiration cannot be established by pilocarpine, no beneficial action is observed. The best results are obtained in early cases.

In **nephrolithiasis** with **anuria** due to renal congestion, Meara recommends, where facilities for the hot pack or hot-air bath are not at hand, pilocarpine hydrochloride in doses of $\frac{1}{10}$ to $\frac{1}{6}$ grain (0.006 to 0.012 Gm.).

Some consider pilocarpine useful as a renal stimulant in doses of $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.002 to 0.003 Gm.), either hypodermically or by mouth.

Pilocarpine is indicated when there are a dry, hot skin, parched mouth, full and strong pulse, with the kidneys not able to perform their work, and the patient is restless or convulsive. A man working on low, marshy land had contracted **malaria**. His temperature was 105° F. (40.5° C.) and pulse 130, full and bounding. He had not had bowel action for three days, nor voided urine for twelve hours. The author gave $\frac{1}{2}$ grain (0.03 Gm.) of pilocarpine hypodermically, and within five minutes ptialism and perspiration became profuse. The patient passed a large quantity of highly colored urine, and soon afterward vomited easily a large quantity of "bilious" matter. In 2 hours the bowels moved freely, and the patient was thus made ready for quinine treatment. E. B. Ellis (Med. World, xxi, No. 9, 1903).

In **retention of urine** of nervous origin, daily injections of 0.01 Gm. ($\frac{1}{6}$ grain) of pilocarpine hydrochloride or nitrate are useful, bladder evacuation generally following in 8 or 10 minutes after an injection. In mechanical or inflammatory retention the procedure is not effective. According to Claude, the **gastric crises** of **tabes** are favorably affected by pilocarpine. Cain and Oury (Presse méd., Oct. 27, 1923).

In **epidemic parotitis** (mumps) pilocarpine has been claimed to afford relief when given early. In the treatment of **orchitis** and **epididymitis** accompanying this affection, injection of $\frac{1}{6}$ grain (0.01 Gm.) of pilocarpine on alternate days is asserted by Martin to shorten the duration of the inflammation, and also act as an anodyne. Harnsberger likewise recommends pilocarpine in orchitis and epididymitis, however caused, including cases of **gonococcal orchitis** in which the usual measures have failed to relieve.

Chronic rheumatic disorders and **sciatica** may be ameliorated by

diaphoretic doses of pilocarpine. In a patient who suffered from two or three attacks of rheumatism yearly, Drapier gave hypodermic injections of $\frac{1}{6}$ grain (0.01 Gm.) of pilocarpine, which led to complete recovery within six days. In **acute muscular** or **articular rheumatic** conditions following exposure to cold, pilocarpine may be used with benefit in the early stages, preferably in small doses and followed by quinine.

The fulgurant pains of **tabes dorsalis** can sometimes be relieved with subcutaneous injections of pilocarpine.

Among the **respiratory affections** in which pilocarpine may prove useful is **acute bronchitis**, in the early stages of which $\frac{1}{20}$ to $\frac{1}{10}$ grain (0.003 to 0.006 Gm.) of pilocarpine nitrate may be given by mouth thrice daily, or somewhat smaller doses subcutaneously, to loosen and augment the scanty bronchial secretions. In **chronic bronchitis** the drug may also prove efficient where the secretions are thick and evacuated with difficulty. The same applies to **plastic bronchitis**, in which small doses of the drug may be given at short intervals to assist in loosening the fibrinous membranes formed in the bronchial lumina. In **chronic atrophic laryngitis** pilocarpine, given in $\frac{1}{10}$ -grain (0.006 Gm.) doses three times daily is of value to promote the secretory activity of the local glandular structures. The local use of from 1 to 5 minims (0.06 to 0.3 c.c.) of fluidextract of pilocarpus to 1 ounce (30 c.c.) of water as a spray has been suggested by J. Solis-Cohen in the same affection. In **bronchial asthma**, in spite of the well-known bronchoconstricting effects of large doses of

pilocarpine, small doses, such as $\frac{1}{20}$ grain (0.003 Gm.), have at times proven of value in the acute dyspneic paroxysms. In **edema of the larynx**, pilocarpine may be used to help deplete the dropsical mucous membrane by causing diaphoresis; great care as to dosage is, however, required to avoid undue circulatory depression in these already partially asphyxial cases, and incision of the affected membrane is a more direct and logical measure.

In obstinate **hiccough**, pilocarpine is one of the numerous remedies which have been credited with beneficial effects. Harnsberger considers it indicated whenever firm pressure upon the base of the tongue fails to give relief, and advises its use also in tonic **spasm of the diaphragm**.

In persistent **catarrhal jaundice**, subcutaneous injection of $\frac{1}{6}$ to $\frac{1}{4}$ grain (0.01 to 0.015 Gm.) of pilocarpine on alternate days has sometimes proven effective in relieving the condition, in spite of the prevailing view that this drug has no stimulating action on biliary secretion. Mitkowski has, moreover, attributed diagnostic value to the procedure; if the treatment produces no effect upon the jaundice, the presence of a malignant growth is to be suspected. In **hepatic colic**, Harnsberger strongly recommends $\frac{1}{8}$ grain (0.008 Gm.) of pilocarpine with $\frac{1}{2}$ grain (0.03 Gm.) of codeine subcutaneously, to be repeated if required.

Probably the easiest and most rapid way to remove **ranula** is by the administration of $\frac{1}{6}$ grain (0.01 Gm.) doses of pilocarpine hypodermically (Harnsberger).

In **skin disorders** characterized by a deficient secretion of the sweat-

glands, and in those of rheumatic origin, pilocarpine has at times proven effective. In **chronic eczema**, Koltz obtained favorable results from hypodermic injections of 10 to 15 drops of a 1 per cent. solution of pilocarpine. Poulet suggests that the same procedure may be of service in the treatment of **elephantiasis**. It has been observed that jaborandi has alleviated **urticaria**, and doses of $\frac{1}{20}$ grain (0.003 Gm.) of pilocarpine have proven remedial in **hyperidrosis** and **bromidrosis**.

In the late **syphilides**, when mercury and the iodides are not effective, pilocarpine, given alone or combined with the antisiphilitic treatment for a period, will often clear the skin. The author has found it most efficient of all remedies in the tertiary stage for **leukoplakia**. Tongues that withstood prolonged antisiphilitic treatment cleared up in two weeks upon the addition of pilocarpine.

In nursing mothers in whom the **mammary function** is **not fully developed** and the secreting cells not sufficiently active, pilocarpine is a valuable galactagogue. G. Merrill Hawkins (Med. Council, Feb., 1913).

Pruritus is not uncommonly relieved by this agent. The **itching of jaundice** is amenable to it if the drug is well borne and diaphoresis ensues. Simon has found nothing so useful as pilocarpine hypodermically in the treatment of **pruritus senilis**. It relieves the itching and allows the patient to sleep.

In **alopecia** the use of pilocarpus internally—or, better, its application locally—seems to encourage the growth of the hair. Pringle has specifically shown that by injection of $\frac{1}{2}$ grain (0.03 Gm.) of pilocarpine nitrate into the scalp, a growth of hair can be obtained. If too much of the

drug is used, small pustules may develop about the hair-follicles. The following application has been suggested for cases of alopecia:—

℞ *Fluidextract of pilocarpus* ʒj (30 c.c.).
Tincture of cantharides. ʒss (15 c.c.).
Soap liniment ʒiiss (45 c.c.).

Sig.: Mix and apply night and morning with friction.

For the same purpose Hare suggests the use of:—

℞ *Fluidextract of pilocarpus* fʒj (4 c.c.).
Tincture of capsicum ʒj (30 c.c.).
Tincture of cantharides fʒss (2 c.c.).
Castor oil fʒj (4 c.c.).
Alcohol, q. s. ʒiv (125 c.c.).—M.

Dryness of the tongue and **aptyalism** may be relieved by small doses of pilocarpine. The dryness of the mouth often so troublesome in **diabetes mellitus** may be alleviated in the same manner. On the other hand, minute doses of the drug have been recommended in the **night-sweats of pulmonary tuberculosis**, in **ptyalism**, and in **bronchorrhea**.

Pilocarpine is useful in all **ophthalmic disorders** associated with increased ocular pressure. De Schweinitz recommends very highly the hypodermic use of pilocarpine ($\frac{1}{10}$ to $\frac{1}{2}$ grain—0.006 to 0.03 Gm.—daily) for **opacities** of the vitreous humor. Diaphoresis should be avoided. As a myotic (1 to 4 grains—0.06 to 0.26 Gm.—to the ounce—30 c.c.) pilocarpine may be substituted for eserine; 1 or 2 drops every hour may be used until the pupil is sufficiently contracted.

Pilocarpine is useful as a tonic to the eye; to relieve **ocular pain** after excessive use of the eyes, $\frac{1}{10}$ grain (0.006 Gm.) of pilocarpine and 4

grains (0.25 Gm.) of boric acid to the ounce (30 c.c.) of distilled water may be used, a few drops of the solution being placed in the eye at a time. Clinical observation has shown that pilocarpine in small doses is a good remedy in **tobacco amblyopia** and **alcoholic amblyopia**. A few drops of a 2-grain (0.13 Gm.) solution of pilocarpine may be employed locally with advantage in **rheumatic iritis**. Staderini advises pilocarpine nitrate, $\frac{1}{10}$ to $\frac{1}{8}$ (0.006 to 0.008 Gm.) hypodermically in many inflammatory diseases of the eyes, especially in those consequent upon rheumatism, as **episcleritis**, **iritis**, and **idiopathic optic neuritis**. Gratifying results have been reported by Hansell from the use of the drug, hypodermically or by the mouth in alkaloidal form, or as small doses of the fluid-extract of pilocarpus, in **interstitial keratitis**, **traumatic purulent iritis**, and **retinochoroiditis**. He confirms the observation that the persistent nausea so common after the use of the drug is usually relieved by small doses of chlorodyne. Bock reported good results from injections of small amounts (2 to 3 cgm.— $\frac{1}{3}$ to $\frac{1}{2}$ grain) of concentrated solutions of pilocarpine in cases of **blood in the anterior chamber**.

Some nerve-specialists place great reliance upon pilocarpine in **toxic insanity** after **influenza**, **autointoxication**, and similar processes, the brain rapidly clearing after two or three sweats.

In cases of obstinate **aural vertigo**, a most efficient treatment is the use of pilocarpine every few days in sufficient doses to produce some salivation, the patient lying down or going to bed after each dose. Labit has re-

ported cases of **Ménière's disease** in which the daily hypodermic use of pilocarpine gave satisfactory results. In **syphilitic deafness** pilocarpine may prove of value when combined with the customary antisyphilitic measures. In **deafness and vertigo due to inflammatory disease of the labyrinth**, injections of $\frac{1}{6}$ to $\frac{1}{8}$ grain (0.01 to 0.02 Gm.) of pilocarpine on successive or alternate days, according to tolerance, are recommended. After an initial dosage of $\frac{1}{2}$ grain (0.005 Gm.), the amount should be increased until free sweating and salivation take place. Where the hearing fails to improve after 12 injections, the treatment should be discontinued (Pershing).

While atropine is a very efficient antidote against poisoning by pilocarpine, pilocarpine is less potent as an antidote in **poisoning by atropine**. McGowan has related a case, however, in which two injections of $\frac{1}{2}$ grain (0.03 Gm.) each were undoubtedly the means of saving the life of a patient suffering from belladonna poisoning. The same procedure is recommended as beneficial in **acute alcoholism** and in **poisoning by methyl alcohol**, in which free elimination of the poison by all possible routes is desirable.

In **tetanus**, the sedative action of large doses of pilocarpine on the spinal cord has occasionally been utilized with success.

C. E. DE M. SAJOUS

AND

L. T. DE M. SAJOUS,
Philadelphia.

PIMENTA.—Pimenta (allspice) is the dried, nearly ripe fruit of *Pimenta officinalis* (family, Myrtaceæ), of Tropical America. It contains from 2 to 4 per

cent. of volatile oil (*oleum pimentæ*), mostly in the pericarp; resin, tannin, fat, sugar, mucilage, etc.

PREPARATIONS AND DOSES.—

Pimenta, N. F. (allspice). Dose, 10 to 40 grains (0.6 to 2.6 Gm.).

Oleum pimentæ, N. F. (oil of allspice). Dose, 1 to 5 minims (0.06 to 0.3 c.c.).

PHYSIOLOGICAL ACTION AND THERAPEUTIC USES.—*Pimenta*, like other drugs containing aromatic oils, is a pungent, aromatic stimulant and is used as a carminative, a flavoring, a digestive stimulant, and to prevent the griping of purgatives. For the last purpose this oil is added to the pill mass. It is occasionally used as an ingredient in spice plasters. W.

PINEAL GLAND, DISEASES AND ORGANOTHERAPY OF.

—PHYSIOLOGY.—This organ has had a varied career. Descartes thought it contained the soul; its connection with the pineal eye of reptilia and other low vertebrates caused it to be classed with the vestigial organs, but it has been raised to the rank of a useful organ. It contains neuroglia and what are regarded as secretory cells. Certain of its follicles contain what is termed "brain sand," also found in the choroid plexus and elsewhere, but devoid, as far as is known, of physiological importance.

As to the functions of the pineal, it has been thought in some way, perhaps through a secretion, to control growth in the young. Destructive tumors of the pineal in children under the seventh year may cause them to become abnormally tall and prematurely developed as to their genital organs, hair growth, and ossification. Obesity is occasionally observed in these cases. In keeping with these clinical facts Sarteschi found that in rabbits pinealectomy

caused great body development, sexual precocity, and notable enlargement of the testes. Notwithstanding all this, the feeding of pineal gland to young animals by Dana, Berkeley, Goddard and Cornell, and McCord also caused them to outgrow the controls rapidly in activity, size, intelligence, and resistance to intercurrent disease, while in children it has been claimed to benefit certain cases of retarded development.

These contradictory results emphasize the fact that little is known concerning the actual functions of the pineal. Some believe that the organ controls growth, its deficiency allowing other glands to stimulate development abnormally. Others have held that its main function is to initiate puberty, presumably through a secretion stimulating the gonads.

Guinea-pigs fed with pineal body differed in no way from the controls, except that development of the testes and ovaries was slightly delayed. In dogs, similar experiments of Biedl produced like effects, thus suggesting that the rôle of the pineal is an inhibitory one, the purpose of which is to prevent overdevelopment of the genital organs during their formation, *i.e.*, up to about the 7th year. Izawa (Jour. Okayama Med. Soc., Mar., 1924).

TUMORS.

Various types of growth are met with in the pineal. The main forms found are sarcoma, glioma, teratoma, psammoma, carcinoma, cystoma, and neuroglioma.

SYMPTOMS.—Tumors usually occur among young subjects. In practically all forms of neoplasms the characteristic symptoms are: Abnormal growth as to height, premature genital and sexual development and also hair growth, a tendency to

obesity, change of voice to that of an adult, and mental precocity (*macro-genitosomia precox*). These phenomena suggest participation of the pituitary body in the morbid process.

Case of a boy who developed normally until the age of 10, but thereafter showed none of the phenomena of puberty. At 17 he appeared like a boy of 12. He then died after a laparotomy which gave no clue to the cause of the hematemesis that had set in 4 days before, and at the autopsy the pineal was found completely wanting, the testes like those of a child of 1 or 2 years, and the thyroid, pituitary, thymus and adrenals apparently normal. This case is held to support the theory of the pineal as an initiator of puberty, and does not support the view of a purely mechanical function, nor any connection with adiposity, cachexia, or idiocy. Zandrén (*Acta med. Scandin.*, Feb. 4, 1921).

The writer quotes Askanazy and Brack as having observed isolated premature sexual development in a girl with hypoplasia of the pineal. He adduces this as supporting his view that precocious puberty in pineal tumors is due to altered pineal function and not the effects of the tumor. Berblinger (*Arch. f. path. Anat.*, Mar. 18, 1922).

In some cases there is hydrocephalus, due to pressure upon the veins of Galen and the aqueduct of Sylvius, the liquid filling first the third ventricle and passing down into the pituitary. The symptoms of disease of the latter may then be added to those of pineal origin.

The writer associates with pineal tumors: (1) A *dystrophic syndrome*, with accelerated growth (though occasionally dwarfism), genital precocity and increased pilous development; (2) a *nervous syndrome*, with cerebral hypertension, headache, vomiting, convulsions, visual disturbances, etc., and (3) a *peculiar ocular syndrome*, with partial paralysis of the rotatory

muscles of the eye, due, according to Spiller, to a lesion of the anterior corpora quadrigemina. With this triple syndrome may be combined obesity and polyuria, which may be due to a secondary involvement of the floor of the third ventricle, and a mental development exceeding that of children of the same age. Lereboullet (*Jour. Amer. Med. Assoc.*, Aug. 26, 1922).

Severe headache, vomiting, great lassitude, deviation of the eyeballs, amaurosis, papillary edema, somnolence, and vertigo are also observed, but these are obviously pressure symptoms. They may be followed later by motor phenomena such as increased muscular tonus, myasthenia, and increased tendon reflexes. Pressure exerted upon the corpora quadrigemina may cause ocular palsies, paralysis of associated movements, and nystagmoid phenomena. If the geniculate bodies and posterior corpora quadrigemina are compressed, there may be tinnitus, crackling and buzzing, and progressive deafness. Pressure on the cerebellum may cause staggering gait; both this symptom and ataxia are not infrequently present.

Polydipsia, polyuria, and glycosuria are occasionally observed, probably when the pituitary body is involved in the morbid process. Giant growth of acromegalic type, sometimes witnessed, is also due in all likelihood to involvement of this organ. In a case described by Herrot, sarcoma of the pineal and pituitary was found *post mortem*.

TREATMENT.—The treatment of pineal tumors is surgical, removal of the growth being indicated. The pineal may be exposed by Monaco's operation, the steps of which are extensive superior median craniotomy, ligation

of the longitudinal sinus, retraction, separation of the two hemispheres and partial splitting of the corpus callosum—all with very strict antiseptic precautions. Where hydrocephalus is present, **lumbar puncture** may be tried.

Outline of a clinical procedure for **pinelectomy**, which the writer carried out in 2 cases. One had an encapsulated tubercle of the pineal and lived 8 months after the operation. In the second case, which had a tumor weighing 26 Gm., death took place in 48 hours. The procedure comprises a large parieto-occipital bone flap, tapping of the lateral ventricle, ligation of the cerebral veins, retraction of the hemisphere to 1 side, splitting of the corpus callosum, ligation of the inferior longitudinal sinus if necessary, division of the falx cerebri if necessary, and enucleation of the tumor. The writer considers decompression and callosal puncture futile in these cases; nothing short of removal of the tumor is of value. Dandy (Surg., Gynec. and Obst., Aug., 1921).

Case in a boy of 9, with rapid growth up to that age, then rapid puberty, headache and convulsions, in which the progress of the condition was arrested by the **X-rays** and **luminal**, the boy then leading his classes in school. Another case, with added eye symptoms, succumbed in 8 months and showed a neuroepitheliomatous glioma with obliteration of the 3d ventricle. Aside from the X-rays, **decompression** and **pineal extract** may be tried. Lereboullet (Prog. méd., Feb. 18, 1922).

ORGANOTHERAPY.—Pineal gland has been asserted to give good results in cases of **retarded development in children**, being held to stimulate normal growth of the body and enhance intellectual activity in certain cases. Where total idiocy and gross physical defects are present no benefit is to be expected. It is doubt-

ful whether such effects are to be ascribed to a secretion. From my viewpoint they are more likely to be due to nucleins the pineal contains.

Pineal extract used in 54 obstetrical cases. In 15 cases the author did not reach his patients until the third stage of **labor**, when he witnessed good effects in **retained placenta** and **hemorrhage**. The results were also excellent in the remaining 39 cases—not inferior to those obtained with pituitary extracts, though in 11 cases he eventually had to use forceps. Wolf (Deut. med. Woch., Aug. 7, 1913).

Two cases in which considerable benefit was obtained from pineal gland—dosage not given. One from his own practice—an **idiot** 7 years old who had never spoken and who in 7 weeks was able to use between 50 and 100 words. The second case, from the literature, was that of a helpless, inert child of 19 months who, after small doses of pineal for 3 months, was "able to stand upright, reach for objects," etc. Berkeley (Amer. Med., Nov., 1924).

C. E. DE M. SAJOUS,
Philadelphia.

PINTA.—Pinta, also known as Mal de los Pintos, Caraate, Tina, Quirica, Pannus Carateus (Alibert), etc., is not applied to a single disease, but to a group of allied dermatomycoses, characterized by the presence of patches of various color, due to different species of fungi of the genera *Aspergillus*, *Penicillium*, *Monilia*, and *Montoyella* (Castellani). Pinta is practically found only in tropical America (Venezuela, Peru, Chili, Central American States, Mexico, and more rarely, Brazil). In Colombia, 4 per cent. of the population is affected (Montoya), and the affected patient is called "caratejo." Dirt and poverty are etiological factors.

SYMPTOMS.—The onset of the disease is very gradual. After an incubation period of from a few weeks to months, one or several slightly itching spots appear on uncovered parts of the body, increase very slowly in size, and may coalesce. They may be round or irregular in shape,

at first but slightly raised, the surface usually dry and rough, and covered with fine pityriatic squamæ in recent cases, but larger and thicker scabs in older ones. In chronic cases the surface of the patches may be moist, somewhat greasy, or glutinous, instead of dry.

The hairs of the affected regions become atrophied and later are shed, due to a fibrosis of the hair-follicle and not to the fungus.

Pruritus, especially at night, is marked. In the palms and soles patches of hyperkeratosis often appear, making the normal lines and sulci apparently deeper. A peculiar, nasty odor, like that of cats' urine or of musty, dirty linen, is noticed in old chronic cases. The whole body, excepting the palms and soles, may become affected. The scalp is seldom affected, the nails never.

The disease is very chronic,—may last a lifetime,—with no tendency to spontaneous cure. Six varieties are distinguished, according to the color of the patches: black, blue, violet, red, yellow, white.

The same patient may be affected with several varieties.

DIAGNOSIS.—In the countries where the disease is endemic, the diagnosis is easy. Microscopic examination, supplemented by cultural methods, will reveal the diagnosis.

TREATMENT.—When the disease first appears the application of **tincture of iodine** may prove effectual. **Mercury nitrate ointment** is much used in Colombia. **Chrysarobin in zinc oxide ointment**, 2 to 6 per cent., may be applied cautiously, but never to the face. For the face a **resorcin** (6 per cent.); or **resorcin 6**, **acid salicylic 2**, **petrolatum 100**; or **citric ointment**, may be used. **Chrysarobin in chloroform** (10 per cent.) is applied with a fine brush to the patch by Montoya, which, when dry, is covered with **solution** (10 per cent.) of **gutta-percha in chloroform**.

When large tracts of the body are the seat of pinta, and chrysarobin is employed, a small portion only should be treated at a time, to prevent absorption of the remedy. Constant watch should be kept on the urine during treatment. S.

PIPERAZIN.—Piperazin (pyrazin hexahydride, diethylene diamine; piperazidin; ethyleneimine) is obtained by the action of ammonia upon ethylene bromide or chloride. It occurs in colorless, transparent, deliquescent needles, which absorb carbonic acid from the air. It is very soluble in water, the solution being practically tasteless and having an alkaline reaction. It must be kept from the air.

Piperazin is incompatible with alkaloids and the salts of iron, tannic acid, alum, preparations of cinchona, Donovan's solution, potassium permanganate, sodium salicylate, acetanilide, and phenacetin.

Dose.—The dose of piperazin is 15 grains (1 Gm.) per day. This quantity is dissolved in a pint of plain or carbonated water and taken in tumblerfuls at equal intervals. The solution must be prepared fresh each day.

It cannot be prescribed in pill form on account of its highly hygroscopic nature.

PHYSIOLOGICAL ACTION.—Piperazin forms with uric acid piperazin urate, a neutral and very soluble salt, even if the uric acid is present in excess. Upon its solvent power over uric acid rests its value in practice. Piperazin will render soluble twelve times as much uric acid as lithium carbonate; moreover, piperazin urate is seven times as soluble in water as lithium urate.

When taken in moderate doses it is quickly eliminated by the kidneys, and gives the urine a brownish-red color. Ebstein and Sprague did not find by examination of the latter that the output of uric acid or urea was increased; indeed, Voght has argued that in doses of 15 grains (1 Gm.) a day it checked uric acid elimination.

POISONING BY PIPERAZIN.—The following untoward effects have been observed when large doses have been given: Feelings of nervousness and apprehension (hallucinations); intermittent clonic spasms of the upper extremities, spreading to the muscles of the abdomen and legs, the patient becoming dazed, unable to think clearly, and for some hours partly unconscious; muscular prostration, with inco-ordination; coarse tremors, uncertainty of gait for several days, due

rather to impairment of co-ordination than to any parietic condition of the muscles.

Slaughter reported a case of poisoning from 20 grains (1.25 Gm.) of piperazin taken at once.

Treatment of Poisoning by Piperazin.—**Cardiac and respiratory stimulants** are strongly indicated. **External heat** should be applied to the limbs and trunk, and the lower limbs elevated. A high, stimulating rectal injection should be administered and the patient catheterized.

The paralytic symptoms (paraplegia) will probably be best relieved with large doses of strychnine.

THERAPEUTICS.—Piperazin was introduced as a solvent of uric acid. It has seemed an effective remedy in various manifestations of the uric acid diathesis. **Renal and vesical calculi** due to the deposit of uric acid have, it is said, been disintegrated and expelled through the use of piperazin. It has been given with the idea of preventing the formation of renal and vesical calculi. It is stated to be useful in irritation and inflammation of the bladder arising from an excess of uric acid in the urine. For this purpose it may be given internally, or the bladder may be irrigated with a 1 per cent. solution.

It has been used in diabetes and seemed more especially useful when this disease was associated with gout. Piperazin is also stated to have been beneficial in renal colic and in hemorrhage from the urinary passages.

ALLIED SUBSTANCES.—**Lycetol.**—This is also known as dimethylpiperazin tartrate; it is claimed that this substance is superior to piperazin, as the tartaric acid is supposed to be converted into carbonic acid, alkalizing the blood and dissolving uric acid. It occurs in a fine, granular, white powder, and is soluble in water. It has a diuretic effect, an agreeable taste, and is non-hygroscopic. It may be used in gout in daily doses of 15 to 30 grains (1 to 2 Gm.).

Lysidin.—This is also known as methylglyoxalidin, or ethylene-ethenyldiamin, and is obtained by dry distillation from sodium acetate with ethylenediamin hydrochloride. It occurs in pinkish, hygroscopic crystals, having a mousy odor. It is readily soluble

in water, and has been recommended by Ladenburg as being non-toxic, five times superior to piperazin in dissolving uric acid, and as not causing digestive troubles or albuminuria. It is given in doses of from 3 to 15 minims (2 to 10 c.c.) of the 50 per cent. solution, daily, in 1 pint (0.5 liter) of cold or carbonated water, in cases of uric acid diathesis and gout. W.

PITCH. See TAR.

PITUITARY BODY, DISEASES OF. See ACROMEGALY, Vol. I; for TUMORS OF, and HYPOPITUITARISM, and also for HYPOPHYSEAL SYNDROME and FRÖHLICH'S SYNDROME, see Vol. I, p. 298, Vol. VI, p. 142, and Vol. VII, p. 157; for PITUITARY ORGANO-THERAPY, see ANIMAL EXTRACTS, Vol. I.

PITYRIASIS.—Pityriasis (seborrhea, dandruff, sebaceous ichthyosis, eczema seborrhœicum) is a disorder of the fat-producing glands of the skin, characterized by an increase, decrease, or alteration in the secretion of sebum, resulting in an oily, crusted, or scaly condition of the skin. Two varieties are recognized, pityriasis simplex (seborrhea sicca) and another, usually called seborrhea oleosa. In the former there is diminished secretion, with an exfoliation of cells; in the latter there is an excessive flow of sebum or seborrheal flux. It may be due to systemic acidosis.

Pityriasis simplex (seborrhea sicca) is commonly observed on the scalp and face. In the former location it is known as *dandruff*, and occurs as fine, branny, whitish or grayish scales which are loose and drop readily from the hair to the coat-collar. The scalp is most often dry and pale, but may present a certain degree of redness. The hair becomes dry, lacks the usual luster, and tends to split.

When the face is affected it is usually found in the eyebrows, at the root of the nose, in the nasolabial furrow, and in the beard. When these parts are the seat of inflammation the condition is called seborrheic dermatitis or eczema. The process may involve the whole face (pityriasiform seborrhea sicca). **Crusted**

forms may occasionally be seen upon the face, scalp, sternum, pubes, umbilicus, or elsewhere, the secretion being greasy, yellowish, or brownish. **Crusta lactea**, or milk crusts of infants, is classified under this affection by Kaposi.

Seborrhea oleosa, the other form of pityriasis, manifests itself as an excessive oiliness of the skin. When the scalp is affected the hair and scalp are greasy, moist, glistening, and sticky, the hair having a tendency to become matted. The oil soon reaccumulates even after thorough washing, and if the scalp is not regularly cleansed the oily matter becomes rancid and it is the source of a disagreeable odor. When the face is affected it is usually seen upon the middle third (forehead, nose, chin, and adjacent parts of the cheek), and the skin is observed to be abnormally oily, and to have a dirty appearance from the adhesion of dust. The sebaceous follicles may be the seat of dark-colored plugs, or an oily secretion may exude from them. The superficial blood-vessels about the nose are usually enlarged.

DIAGNOSIS.—The dry form is differentiated from eczema by the absence of inflammation. The oily variety is easily diagnosed by the greasiness of the skin and the enlarged pores.

ETIOLOGY.—Sabouraud has studied and described a microbacillus which he claims is pathogenic in the oily form. The dry form is believed to be due to coccic infection of parasitic origin, and unrelated to the oil-glands.

TREATMENT.—In the way of general treatment, **outdoor life, exercise, bathing**, etc., are advised. Duhring recommends **calcium sulphide**, $\frac{1}{2}$ grain (0.012 Gm.) three times daily. Sabouraud favors the natural **sulphur waters** (Luchon, Calles). **Codliver oil, iodine, phosphorus, iron, and arsenic** are useful.

Local Treatment.—**Remove the crusts or scales** and then use **stimulating and astringent applications** to restore the normal functions of the glands. To soften the crusts upon the scalp, Schamberg advises the use of **salicylic acid**, 1 dram (4 Gm.) in **olive oil**, 6 ounces (180 Gm.), followed by the use of **tincture of green soap** to remove the **débris**. The green

soap is used alone if the hair is greasy, using only gentle friction, so that the scalp may not be unduly irritated. A small amount of **sulphur ointment** (1:8), rubbed into the scalp, is valuable, and Schamberg combines with it a **resorcin lotion** (1:24) made of equal parts of alcohol, cologne-water, and plain water. The lotion and ointment are used on alternate nights. If the scalp becomes too dry, **glycerin**, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) may be added; if more stimulation is desired, add **betanaphthol**, 30 grains (2 Gm.) to the lotion.

Mercurial ointment and **lotion** may be used on the scalp, but not in connection with sulphur. **Mercury nitrate** or **ammoniated** in benzoated lard (6 to 8 per cent. ointment) may be used, or a lotion of **mercury bichloride**, 1 to 3 grains (0.06 to 0.20 Gm.); **glycerin**, 1 dram (4 Gm.); **bay-rum**, 6 ounces (180 c.c.). When employed upon the face the remedies must be of milder strength: a **resorcin lotion** (1:48), or an **ointment of resorcin and precipitated sulphur**, of each, 10 grains (0.6 Gm.) in lanolin and cold cream, of each, 4 drams (15 Gm.).

PITYRIASIS ROSEA.

Pityriasis rosea (pityriasis maculata et circinata; herpes tonsurans maculosus) is a rare disease, first described and named by Gilbert. It may or may not be ushered in with fever, though fever is seldom absent, and usually with severe headache. Macular or maculopapular patches, principally on the trunk, appear after the fever. The face and limbs are sometimes invaded, and more rarely the affection begins upon and is limited to the upper extremities. The lesions may be elevated slightly, on the level of the skin surface, or may be depressed. The patches vary in size from a pin's head to a split pea, or larger, and may be either isolated or confluent. They are round or oval, mostly light or dark red, gradually becoming yellow, and are dry and scaly, with a tendency to spread at the periphery and heal in the center. A zone of erythema surrounds the primary lesion. Neighboring patches may coalesce, forming semi-circles, circles, or disks, when the typical lesion has a yellowish or fawn-colored

center, with pinkish, slightly elevated border covered with branny scales. Glandular enlargement may be present. The disease is self-limited, lasting from two to eight weeks, usually six. Itching is slight, but may be severe at night.

ETIOLOGY.—The rarity of the disease and its self-limitation suggest that some antitoxic substance is produced in the body. The cause is obscure and the contagion feeble, if present.

DIAGNOSIS.—From **ringworm** it is distinguished by the absence of the specific fungus. From **seborrheic eczema**, which may resemble it when situated upon the trunk or limbs, the presence of seborrhea, seborrheic scales, or eczema of the scalp is of diagnostic value. Patches of **psoriasis** develop and extend more slowly, the scales are more silvery and profuse, and the scalp and extensor surfaces the usual sites.

PROGNOSIS.—Always favorable. It disappears spontaneously.

TREATMENT.—There are no internal remedies of any value. Mildly **stimulating and antiseptic ointments** may be used locally—**betanaphthol** or **sulphur** (10 per cent.). When the itching is annoying, Schamberg uses the following lotion: **phenol** and **glycerin**, each 1 dram (4 Gm.); **witchhazel extract**, 1 ounce (30 c.c.); and water to make 8 ounces (250 c.c.). Barduzzi advises **plain diet, alkaline diuretics**, and, perhaps, a **saline cathartic**.

PITYRIASIS RUBRA.—This disease has been treated under **DERMATITIS EXFOLIATIVA** (see vol. iii, p. 806), the term most usually applied to pityriasis rubra.

PITYRIASIS VERSICOLOR.

This is a vegetable parasitic skin disease characterized by furfuraceous, yellow, macular patches (flava), occurring chiefly on the trunk. Castellani describes two other varieties (alba and nigra) which are seen in the tropics in addition to that best known in the temperate zones (flava). It is also known as **tinea versicolor** and **chromophytosis**.

SYMPTOMS.—Pityriasis versicolor flava is first seen as pinhead- to pea-sized, yellowish macules, distributed over the affected region. In the course of a few weeks or months they grow larger

and coalesce, forming large patches, which are irregular in shape, have sharply defined edges, slightly elevated above the surface of the skin, but occasionally raised sufficiently to form a ring (annular form). The typical color is *café au lait*, or fawn-colored; exceptionally it may vary from a pale yellow to a brown, or it may be pinkish; in negroes it may be grayish. Fine, furfuraceous, mealy scales cover the affected region.

It pursues a chronic course, disappearing or growing less in the cold months and reappearing with the warm season. It is an adult disease and but slightly contagious.

ETIOLOGY.—This disease is caused by the presence and growth of a vegetable fungus first described by Eichstedt in 1846. Robin called it *Microsporon furfur*. Castellani terms it *Microsporon tropicum*. The variety known as pityriasis versicolor alba is due to *Microsporon macfadyeni*, and pityriasis versicolor nigra to *Microsporon mansonii*.

DIAGNOSIS.—This is made by finding, under the microscope, the characteristic fungus, in scrapings from the fawn-colored patches on the patient's trunk. The spores may be more easily seen if the scrapings are mounted in a solution of equal parts of glycerin and alcohol. **Chloasma** is seen usually in the face, and is not scaly. The same applies to **vittigo**, and in addition there is a lack of color in the patch, which is surrounded by an excess of pigment. The **macular syphiloderm** is more red, and there is more symmetry and more uniformity in the size of the patches.

PROGNOSIS.—The prognosis is good, but relapses are frequent, as the fungi in the skin are usually not thoroughly destroyed.

TREATMENT.—Hot baths, frictions with **sapo mollis**, and the application of a **parasiticide**—solution of **sodium thiosulphate** (1:8), or of **mercury bichloride** (0.2 per cent.) will cause its disappearance in a few weeks. Lotions or ointments of **sulphur**, **mercury**, **tar**, **thymol**, **resorcin**, etc., may be used. In all cases the applications should be continued for some time after the eruption has disappeared, to prevent relapse.

W.

PLAGUE (BUBONIC PLAGUE).

—**DEFINITION.**—A virulent infectious disease due to a specific organism, the *Bacillus pestis* or, according to a later nomenclature, *Pasteurella pestis*, characterized by the formation of one or more buboes, or by the development of a violent form of primary confluent pneumonia.

In India, out of 6,842,980 cases, 5,571,288 died. The disease has never been known on the Atlantic Coast of the United States. While in 1894-95 it was confined to one country (China), it later extended to every continent, obtaining a foothold in 51 different countries, including Hawaii, the Philippines, California, and Washington (Seattle).

A slight epidemic of plague occurred in Paris in the latter half of 1920. Plague-infected rats were found in the city. In one instance a man had been sent to the hospital with a diagnosis of strangulated inguinal hernia; in 2 other cases the acute symptoms suggested typhoid or pneumonia until the buboes appeared. In each of these 3 cases plague bacilli were found in the blood, and the septicemia proved fatal in 2 to 7 days from the onset, in spite of serum treatment. Joltrain and de Gennes (Bull. Soc. méd. des hôp. de Paris, Dec. 9, 1921).

In the Porto Rico epidemic of 1921, the symptomatology of acute parenchymatous nephritis was the first to appear. The epidemic was preceded by the finding of numerous dead rats in the streets. More than 78,300 rats were examined; the plague bacillus was found in 93. The rats came from 10 different localities, but San Juan was the main focus. Ortiz (Porto Rico Med. Assoc. Bull., Mar., 1923).

VARIETIES.—Two main varieties are usually recognized: The *bubonic*, making up about 80 per cent. of all cases, in which buboes appear in the femoral, inguinal, axillary, cervical, or tonsillar regions, and the *pneumonic*, in which no buboes appear on the surface, the septic process mani-

festing itself mainly in the lungs, mesentery, gastrointestinal tract, kidneys, or brain. Besides these, three rarer forms have been identified: The *septicemic*, a severe type in which the blood and lymphatic system is overrun with plague bacilli; the *cellulocutaneous*, in which the skin and often the lymph-nodes are the seat of infection, and *Pestis ambulans* or *minor*, a mild form in which the lymph-nodes are affected. An *intestinal* form is also sometimes set apart.

SYMPTOMS.—After an incubation varying from two to seven days, the disease is suddenly ushered in with a chill, the temperature rising somewhere between 101° and 105° F. (38.3° to 40.5° C.). The patient reels like a drunkard, owing to marked vertigo, and complains of violent headache and great lassitude. This sudden and early exhaustion is apparent in the features, the drooping eyelids, the apathetic air, and the evident indifference to surroundings constituting the *facies pestica* characteristic of the disease. The patient complains of general neuromuscular pains or aches. The pulse becomes rapid—a sign of importance in this disease. The respiration is also rapid, as a rule; the face and conjunctivæ are congested, and keratitis, iritis, or panophthalmia are sometimes observed. The tongue is swollen, shows the impression of the teeth, and is covered with a whitish fur resembling mother of pearl. The bowels are as a rule constipated, but diarrhea may supervene. There is usually a polynuclear leucocytosis.

In severe cases (*pestis siderans*) the patient soon falls into collapse, the urine is scanty or suppressed; delirium and uremic coma or convul-

sions supervene, and the patient dies, in a fourth of the cases, in twenty-four hours or less.

In the *bubonic* form the bubo appears during the first twenty-four or forty-eight hours of the malady, and is usually unique. In the order of frequency it presents itself in the groin, the axilla or the neck, or internally. It develops with rapidity on one or both sides and may be well advanced as early as the beginning of the second day; it is always very sensitive to the touch almost from the start. The neighboring tissues are tumefied and edematous, especially in the parotid region. When this locality is invaded edema of the larynx is to be feared.

On the second day the bubo is about the size of a pigeon's egg, and there is aggravation of all the constitutional symptoms, the pulse reaching sometimes 140. Delirium now appears and the stage of apathy is replaced by one of excitement, during which the patient may try to get up. Psychical disorders become manifest, fixed ideas predominating. Functional disturbances of speech are also frequently observed. On the third day all the symptoms become still further aggravated, the pulse reaching 140 or beyond, and the bubo attains perhaps the size of a hen's egg, and suppurates. Occasionally it becomes gangrenous. Carbuncles may develop in different parts of the organism. Extensive petechiæ are usual: the "plague spots" of older writers. Hemorrhages from mucous membranes, the nose, the lungs, etc., are frequently observed. In some epidemics hemorrhages are witnessed in all cases, the buboes assuming an hemorrhagic type.

Death, in the majority of fatal cases, generally occurs about the fourth day, either from toxic paralysis of the respiratory or cardiac centers or from collapse. If the first four or five days—the acute stage—are passed safely, the chances of recovery are favorable. On the other hand, a stage of marasmus or profound depression may appear on the fifth day and the patient succumb on the sixth. Much depends upon the condition of the heart. Some cases, especially in children, are very benign, showing but an insignificant rise in temperature, slight inguinal or axillary pain, general depression, and ephemeral torpor. Such cases, however, are apt to occur early in the course of an epidemic. On the whole, the disease shows a very high rate of mortality.

In the *pneumonic* form the pulmonary inflammation closely resembles incipient influenza and does not show clear physical signs. It is characterized by the development of patches of bronchopneumonia without apparent or noticeable implication of the lymphatic system. It also begins with a chill, severe pain in the side, and more or less severe cough, serosanguineous expectoration, and other phenomena recalling a pneumococcic pneumonia. The fever is usually high; delirium and prostration are very marked. The plague bacillus is always found in the latter. In this variety death may occur in from twenty-four hours to five days, and occurs in about 95 per cent. of the cases.

During normal and dyspneic respiration of primary pneumonic plague patients, plague bacilli are not usually expelled by means of the ex-

pired air. During the coughing of such patients, even when sputum visible to the naked eye is not expelled, plague bacilli in large numbers may become widely disseminated into the air surrounding the patient. Strong and Teague (Jour. Amer. Med. Assoc., Oct. 14, 1911).

Pneumonic and bubonic plague are different diseases. While bubonic plague is transmitted from the rat to man, and rarely from man to man, pneumonic plague has no connection with rats, and is extremely contagious from man to man, entails no buboes, affects the lungs from the start, and is almost always fatal. In Africa it has occurred in small epidemics ever since the influenza epidemic of 1918, and was not confined to ports. Nicolle and Gobert (Arch. de l'Inst. Pasteur de Tunis, June, 1924).

In ordinary epidemics of bubonic plague, according to Judson Daland, only $2\frac{1}{2}$ per cent. are pneumonic, while secondary pneumonia in bubonic plague occurs in about 6 or 7 per cent. of cases. There is no exact knowledge of why the *B. pestis* should cause pneumonic plague. It is more than probable that during an epidemic of bubonic plague the cases of pneumonic plague are not all recorded, because of the difficulty of making an exact diagnosis, and the quickness with which death occurs. The first case of pneumonic plague diagnosed in Bombay was that of Major Manser, one of the faculty of the Grant Medical College. Prostration was extreme, fever moderate, dyspnea absent, and the pulse-respiration ratio unchanged. The amount of lung involved was small. The sputum consisted of pinkish serum containing many plague bacilli. He died on the fourth day, and the following day his nurse showed signs of the same disease, and died three days later.

In the *septicemic* form, which is characterized by intense infection, the fever is not high, owing to the correspondingly great depression of all functions. The other symptoms described occur in rapid succession, the patient dying, however, even before the lymph-nodes have had time to be-

come perceptibly enlarged. This variety of plague is almost universally fatal.

Pesticemia is an earlier, more constant, and less lethal accompaniment of plague than is usually thought. De Almeida considers there is always a primary septicemia. In the writer's 6 cases the blood cultures were uniformly positive, sometimes 2 days before the appearance of buboes. All recovered under **antiplague serum**. Gonzaga (Brazil med., Feb. 11, 1922).

The writer obtained plague bacilli from the blood of 9 out of 12 cases, which included the mildest type. Teissier (Bull. Soc. méd. des hôp. de Paris, Feb. 11, 1921).

The *cellulocutaneous* form resembles, in its general manifestations, bubonic plague; but there occurs, besides, inflammation and necrosis of the cutaneous and subcutaneous tissues, with spreading. A line of demarcation is sometimes formed and a sphacelus eliminated.

In *pestis minor* or *ambulans*, the morbid process is milder, with swelling and sometimes suppuration of the lymph-nodes and a slight elevation of the temperature during a few days. The patient, in a large proportion of cases, can and does go about—a source of danger to others; for, though mild, this form is also very infectious.

A young man was kept under surveillance at Tripoli because he had been living with another who had developed the cutaneous form of bubonic plague. The first young man was apparently healthy, but the lymph-nodes in the groin and axillæ were enlarged on both sides. Puncture of one of the lymph-nodes in the groin revealed plague bacilli. This young man was evidently a healthy bacillus-carrier. A. Ilvento and M. Mazzitelli (Riforma medica, March 28, 1914).

DIAGNOSIS.—The sudden exhaustion and weakness at the commencement of the disease are characteristic; no other fever, especially on the first day, is characterized by such extreme debility. Neither is the moist, non-tremulous, mother-of-pearl-like tongue of Bulard met with in any other disease.

The possibility of *Bacillus pestis* infection should always be considered in a case of sudden marked prostration, with severe headache, vomiting, fever, early delirium, and a focus of lymphatic enlargement and tenderness. The diagnosis cannot, however, as a rule be made positively without a bacteriological study. This should be carried out with material secured by gland aspiration, smears of which usually show numerous typical bacilli. The characteristic growth of the organism on various media and certain peculiarities of behavior in cultures render the diagnosis so certain that the death of guinea-pigs inoculated with gland material is merely confirmatory. Wade and Staring (Amer. Jour. Trop. Dis., Oct., 1914).

The typical symptoms, the bubo, examination of the fluid in the latter and of the sputum for the plague bacillus in the pneumonic form, examination of the blood for bacilli, can hardly mislead.

In a suspicious case careful and continuous observation of the superficial lymphatic glands should be maintained, and puncture with the needle and examination of aspirated fluid made by smears and culture methods. The early identification beyond any doubt of bubonic plague depends upon the microscope. It is the duty of the attending physician to submit to the bacteriological laboratory slides made from the fluid aspirated from every suspicious bubo, and from sputum in every case of pneumonia showing more than ordi-

nary depression at the outset with a bright-red sputum instead of the typical rusty sputum of ordinary pneumonia. The services of the public bacteriologist should be available. J. B. Guthrie (N. Y. Med. Jour., April 5, 1913).

The specific organisms have been shown by Kitasato to persist in the blood for three or four weeks after the onset of the disease. Examination of the blood, however, may be fallacious, owing to variability of the bacillus, leading to confusion with other forms. The best confirmatory evidence is the result of a broth or agar cultivation. Inoculation experiments are also advisable, and, as the infection is often a mixed one, the animals used should have been previously subjected to "vaccination" against streptococci. A fair quantity of blood should be used and kept at a temperature of 37° C. (98.5° F.) for ten or twelve hours before being cultivated. The urine practically always contains albumin and plague bacilli, the latter often persisting for a week after convalescence.

In plague work, great care should be taken in handling infected animals, cultures, and other material. Even persons accustomed to bacteriological laboratory work had to be reminded of danger, as several cases of laboratory infection were on record. The principal things to look out for were fleas from animals, skin abrasions, soiling of fingers, use of pipettes, and smoking. R. L. Wilson (N. Y. Med. Jour., April 5, 1913).

Plague bacilli are found in long and short forms, with an intermediate stage. Their length appears to be inversely proportional to the nutritional value of the culture medium. The most characteristic appearance is that of sharply and repeatedly bent chains

of immobile spindle-shaped bacteria, almost as small as cocci. They are decolorized by Gram's method, and with weak solutions of staining reagents show a clear space in the center of the rod (bipolar staining). The bacillus grows aerobically and anaerobically; it causes acid formation, but will grow in quite strongly alkaline solutions. It forms characteristic growths on agar and in bouillon.

The best culture medium is an alkaline solution of peptone containing 1 or 2 per cent. of gelatin. The organism is pathogenic to all the small laboratory animals with the exception of pigeons. By the second day an inoculated animal is either dead or very ill, and an absolute diagnosis can be made (Curry).

The plague bacillus is rapidly killed by drying at a temperature of 86° F. (30° C.) and upward, over concentrated sulphuric acid, but is much less affected by slow desiccation at lower temperatures. Even at the room temperature, rapid drying is much more lethal to it than slow drying in tissues and fabrics.

The agglutination test becomes definitely positive too late to be of diagnostic service, except occasionally for determining whether a convalescent has actually had the disease.

ETIOLOGY.—Small rodents, squirrels, rats, etc., die in great numbers during epidemics of plague—rats particularly. Indeed, plague is considered to be primarily a disease of rats, and only incidentally a disease of man. Rat-fleas propagate the disease among rodents, and also transmit it to man, mainly when, because of heightened virulence, many rats die of the disease and the fleas thus deprived of nourishment seek susten-

ance from human beings. In Bombay it has been determined that the proportion of plague-infected rats rapidly rises from the normal 3 per cent. about ten days to two weeks before a plague epidemic in man becomes recognized. The flea chiefly concerned is *Zenopsylla cheopis*. According to the investigations of the Plague Research Commission, the rat-flea is the only means of transmission, and the disease is not acquired through the air, from the earth or otherwise, except through the sputum from cases of pneumonic plague. Bedbugs, flies, etc., may harbor plague bacilli, and may, it is believed, transmit infection to a limited extent from one human being to another, but are of no importance in propagating the disease among the rats themselves.

In an epidemic of plague in California, the plague bacillus was transmitted among ground squirrels by fleas, which also attacked man. In South America, the guinea-pig, and in Siberia, the tarbagan, have been found to act as reservoirs of plague infection. Whereas all rodents are very susceptible to plague, this is not true of dogs, birds, snakes, or the fleas themselves.

The Institute of Experimental Medicine at Petrograd, investigating 81 endemic foci in southeastern Russia during the preceding 3 years, found that infection of the skin transmits the bubonic form of plague, while droplet infection is responsible for the pneumonic. The plague bacillus survives for 6 months in winter in human cadavers and animal carcasses. In summer it survives but 1 month, on account of the putrefaction. Wild rodents are the reservoirs of infection, but camels become infected and can also start an epidemic in human beings. Zabolotny (Ann. de l'Inst. Pasteur, June, 1923).

After the activity of the plague bacillus has reached a certain potency, human beings are assailed, as well as the lower animals, the latter succumbing first. The tissues most vulnerable to the Kitasato bacillus are the skin and the mucous membranes, especially when these are deprived of their protective covering. Yamagiwa found a wound of the surface in 1 out of every 7 cases examined. Most infections are believed to occur through the skin of the limbs and trunk. Less important portals of invasion are believed to be the alimentary and respiratory tracts. Once beneath the surface, the bacillus enters the lymphatic system and thence invades the system at large.

In Eastern infected regions the writer found that the disease was not transmitted nearly so much if every one was compelled to put on shoes and stockings. All of the soldiers used in quarantine duty, and who were in close contact with plague cases, were **compelled to wear shoes and stockings**, and not one contracted the disease. The author was always careful not to stoop too closely over a pneumonic case so as to **avoid the breath or coughing of the patient**, and also to **keep his leggings saturated with coal oil to keep the fleas away**. In the town of Petchaburi a great number of children died, and it was found on investigation that the rats having died, the fleas took up their habitat on the dogs, and the children, petting the dogs, suffered in proportion. C. S. Braddock (N. Y. Med. Jour., Aug. 31, 1912).

The plague bacillus, according to Noguchi, is not devitalized by a three weeks' exposure to a temperature of -11.2° F. (-24° C.) This bacillus can develop slowly, but steadily, at a temperature of from 68° to 80.6° F. (20° to 27° C.). Near the freezing

point it remains inert. The disease seems to develop best in moderately warm weather. High altitudes do not afford protection from it.

Intensive fixation by passing through the flame does not kill the bacilli in thin smears from a plague bubo. Even brief fixation by alcohol after passing through the flame does not kill with certainty. Preparations stained with diluted carbol-fuchsin may still contain living bacilli even when treated previously with alcohol for a short time. By staining with concentrated alkaline methylene blue, however, the bacilli seem to be killed. The wash from the stained plague smears may contain plague bacilli, and must, therefore, be disinfected, and likewise the filter paper used for drying the stained preparations. (Nat. Med. Jour. of China, Feb., 1926).

Although all classes suffer, certain conditions of life appear to confer immunity—doubtless by modifying the extent of exposure to infected rat-fleas. Persons living indoors are more likely to suffer than those who spend much time outside. The boat-ing population of China, who live exclusively upon the water, seldom suffer. Persons who occupy the upper stories of a dwelling are less frequently attacked than those living upon the ground floor. The infection may, it is claimed, be transmitted by means of body linen, clothes, bedding, rags, bagging, carpets, etc., and likewise, under suitable conditions, by foodstuffs, grain, sweetmeats, etc. Few nurses or attendants upon the sick are attacked if their habits are cleanly; even those whose duty includes the disinfection of infected dwellings have been free from the disease when personal cleanliness obtained. During an epidemic in Canton, in which upward of 30,000 Chinese died, not one of the 300

American or English residents was affected.

PATHOLOGY.—In the buboes and the involved glands bacilli are found in enormous numbers, both among the cells of the gland-tissue and among the lymphatic vessels and the blood-corpuscles extravasated into the gland, as well as in the hemorrhage outside the gland. In cases of plague septicemia they are similarly present in the large characteristic glands. In the kidney the bacilli can also be seen, especially among the blood-cells of the tubules into which hemorrhage has occurred. In the spleen they are also present, among the cells of the splenic tissue and in the hemorrhagic areas. They are found in the liver, especially in cases in which engorgement and hemorrhage were marked. The bacilli are present in the pneumonic areas of plague pneumonia, in profusion among the catarrhal epithelial cells and leucocytes that fill the alveoli and terminal bronchioles, as well as among the blood-corpuscles of the alveoli into which hemorrhages have occurred.

The writers' study of the human lesions, and those produced experimentally in animals, showed that epidemic plague pneumonia results from inhalation, the primary point of infection being the bronchi. Along the bronchioles the infection extends by continuity directly into the infundibulum and air-cells, or by contiguity through the walls of the bronchioles to the contiguous tissue of the lung, and gives rise to a consecutive peribronchial inflammation in the tissues immediately surrounding the bronchioles. From these areas the infection rapidly spreads to the adjacent pulmonary tissue and visceral pleura. The bacilli rapidly multiply and produce at first pneumonic changes of the lobular type, and shortly afterward,

from the fusion of several rapidly spreading areas, more general lobar involvement of the lung-tissue. The blood becomes quickly infected and a true bacteremia results in every case. Strong, Crowell, and Teague (*Philippine Jour. of Sci.*, June, 1912).

The lungs were found to be the seat of hemorrhagic seroexudative pneumonia in 9 autopsies, and a cellular exudation in 4 others. The period of survival was less than 80 hours in the cases examined. Tsurumi, Hara, Ima, Awok and Sakamoto (*Japan Med. World*, July, 1923).

TREATMENT.—The medicinal treatment of plague, judging from the great mortality of that disease—30 to 100 per cent.—does not seem to merit much confidence. Calomel has been largely used. According to Cantlie, it should be given in from 5- to 10-grain (0.3 to 0.6 Gm.) doses, and be followed by a saline in some five hours' time.

From the very onset, or certainly after twenty-four or forty-eight hours, it will be found necessary to stimulate the patient by food and alcohol or other drugs. Food should be given in small quantities, frequently repeated, and of a kind that is easily digested. Beef preparations, in fluid or jelly form, are recommended. Ox-tail soup, mutton-broth, and chicken-broth are also useful. Milk with ice, sipped slowly, and ice-cream are particularly grateful.

The writer begins treatment with **magnesium sulphate** and **calomel**, followed next morning, if necessary, by **castor oil**. If the temperature is 39.4° C. (103° F.) or over, he gives 1 Gm. (15 grains) of **antipyrin**, repeated, if necessary, some hours later. This controls the headache, delirium, and restlessness. About 20 minutes after the antipyrin 30 c.c. (1 ounce) of **brandy** is always given. **Eggs, milk** and **brandy** are given 5 times a day in the

acute stage. He disapproves of puncturing the acute buboes, and also warns against placing pneumonic plague patients in a ward with those having ordinary bubonic plague, as it is quite possible for the former to infect the latter (2 different types of *B. pestis* are concerned). The mortality among cases not previously inoculated was 58 per cent.; in those inoculated it was lower. Hornabrook (Med. Jour. of Austral., Apr. 15, 1922).

Thirst is a marked symptom, and **ice to suck**, if not kept up too long; water or **lemon and water** (not lemonade) to drink, and **brandy** or **whisky** diluted with water (not aerated waters) may all be used.

When the pulse shows signs of failing or collapse or faintness supervenes, **alcohol** is commonly used, and **brandy** is preferable to whisky. Active delirium may be controlled by **cold to the head**: **Leiter's coils**, **ice-bag**, or **wet cloth**. **Scopolamine** in $\frac{1}{400}$ -grain (0.00065 Gm.) dose hypodermically is the most efficient and safe of the hypnotics. **Morphine**, in $\frac{1}{8}$ - to $\frac{1}{4}$ -grain (0.008 to 0.016 Gm.) dose subcutaneously with **atropine**, is most useful when painful adenitis complicates the cerebral intoxication.

Diarrhea may be treated by **salol** in 10-grain (0.6 Gm.) doses or by a **suppository of morphine**, $\frac{1}{4}$ grain (0.016 Gm.), and **cocaine**, $\frac{1}{2}$ grain (0.03 Gm.). Vomiting may be controlled by a **mustard-plaster** to the **epigastrium**, **ice to suck**, and **morphine**.

For pyrexia, chemical antipyretics should not be used, but frequent **sponging with tepid water**, **ice to the head and nape of the neck**, **iced drinks**, and a short application of the **wet pack**. **Smelling-salts** and **strong ammonia** to the nostrils often arouse a patient in collapse and permanently revive those apparently moribund.

Hypodermic injections of **ether** should be used frequently and freely. Internally, **ammonium carbonate** in a tincture or decoction of **cinchona** is most useful. **Camphor** may be given hypodermically in sterilized oil. **Musk** may be administered in 5-grain (0.3 Gm.) doses every six hours. **Strychnine sulphate** in $\frac{1}{48}$ -grain (0.0013 Gm.) dose hypodermically in 10 minims (0.6 c.c.) of boiled water may be of service. **Inhalations of oxygen** are also recommended. **Abscesses** should be **opened when they point**.

The writer gave **adrenalin chloride** a trial. For adults 31-minim (2 c.c.) doses of the 1:1000 solution were at first usually given by the mouth, with 10 minims (0.6 c.c.) of **tincture of strophanthus** every 4 hours for the first 3 days and 3 times daily thereafter for approximately another 14 days. Later, especially if the patient was extremely ill on admission, it was usual for the adrenalin to be given hypodermically or intravenously in somewhat similar doses until the patient was out of danger, when it was given by the mouth. The hospital mortality from bubonic plague (excluding septicemic cases) in patients not treated with adrenalin was 37.4 per cent., as compared with 26 per cent. among those receiving it. Thornton (Lancet, April 9, 1910).

Early **crucial incision** into the **swollen glands** employed in 62 cases, with 54 recoveries. It causes immediate improvement in patient's condition, temperature being lowered and headache alleviated. The wounds were dressed with **iodine** lotion, 1 dram to the ounce (4 c.c. to 30 c.c.) of water. Nesfield (Lancet, Nov. 4, 1911).

Intravenous use of a solution of **iodine**, 1 dram (4 Gm.); **potassium iodide**, 1 ounce (30 Gm.), and **alcohol**, 20 ounces (600 c.c.) advocated. A small amount is freshly prepared for each case, and 10 or 15 minims (0.6 to 1 c.c.) in about 2 ounces (60 c.c.) of distilled water, warmed to body tem-

perature, are injected at a dose. If the temperature fails to descend 1 or 2 degrees in 12 hours and remain lower permanently, another dose of $\frac{1}{2}$ the size is given. Injection of the full dose is repeated on alternate days until the temperature is normal, after which a single additional dose is given. Vassallo (*Jour. of Trop. Med. and Hyg.*, Apr. 1, 1921).

The writer injects a 0.5 per cent. solution of **iodine** into the glands affected by bubonic plague, giving 4 injections of 0.5 c.c. (8 minims) daily. The injections cause edema around the glands. If the latter suppurate, he injects a solution of **iodine in alcohol** or **glycerin**. All of his 17 patients recovered. Ilvento (*Policlin.*, Oct. 22, 1923).

In 3 cases receiving an injection of a **bacteriophage** into a bubo within a day after appearance of the latter, the general condition began to improve within a few hours after the injection. Another case, treated only on the third day, required 2 injections. All recovered. F. d'Herelle (*Presse méd.*, Oct. 21, 1925).

Serotherapy.—Serotherapy, though by no means a specific, seems undoubtedly to reduce the death rate. **Yersin's serum** is said to have reduced the mortality of severe cases from 90 to 50 per cent. and that of mild cases from 50 to 10 per cent. This serum is prepared in Paris by intravenous injections into horses of dead and later of living plague bacillus cultures. **Kolle's serum** is prepared by injections of heat-killed cultures, while **Lustig's serum** is obtained by injections of plague bacillus nucleoproteins. In plague cases large doses of serum should be given early; Choksy obtained a mortality of but 30.3 per cent. when the serum was injected on the first day, as against 62.5 per cent. when delayed until the third day. Choksy (quoted by Daland) injects 100 c.c. of the French serum

twice daily at 6-hour intervals, and later continues its use in smaller doses; he also stresses the use of **adrenalin**, **caffeine**, **sparteine**, **strychnine**, and **brandy** to support the circulation. The serum is most effective when given intravenously. Where, in children, this route is not practicable, the intramuscular or intraperitoneal route may be used.

The writer injects 90 to 100 c.c. of serum in adults— $\frac{1}{2}$ intravenously and $\frac{1}{2}$ subcutaneously in the region of the bubo. (In children, about half this amount.) He also injects pure **phenol** into the enlarged gland or glands—from 10 to 20 drops (presumably of a saturated solution) for each patient, and gives **methenamine** to the limit, *i.e.*, until the patient complains of considerable bladder irritation. Two cases treated with methenamine and phenol injections (without the use of serum) recovered. P. J. Todd (*China Med. Jour.*, May, 1913).

From cases studied in Paris, the writers concluded that **anti plague serum**, given early and persistently, is of great value. In a considerable series there were no deaths, except in 3 patients who died in a few hours after admission. In the more severe cases sometimes 100 c.c. of serum was given intravenously twice daily. Serum reactions were frequent, and seemed to affect the buboes favorably. Early incision of buboes or other local measures did not appear to modify their course. Teissier, Tanon and Gastinel (*Bull. Soc. méd. des hôp.*, Feb. 11, 1921).

On the basis of experience in the Porto Rico epidemic, the amount of **antitoxin** required for a moderately severe case is greater than is indicated in textbooks; from 250 to 500 Gm. should be injected at 6, 8, or 12-hour intervals at first. Lavandero (*Bull. of the Porto Rico Med. Assoc.*, Mar., 1923).

PROPHYLAXIS.—When plague prevails, the **extermination of rats**

is of primary importance; the methods of doing so which have proved most efficacious are traps and poisons. During the illness, the **disinfection** required is very much the same as in a case of typhoid. Nurses should be warned of the possibility of infection through an abrasion of the skin, and any **abrasions** present ought to be **protected by collodion**.

There are 3 methods all of which must be pursued in order to attain **rat extermination**. These in the order of their importance, although not of period of adoption, are:—

1. The destruction of the nests.
2. The deprivation of food.
3. The killing of the rats themselves.

In the immediate presence of an epidemic, the last named should take the precedence. The means for this are traps and poisons.

Rats can be deprived of much food by strictly covering up every particle of refuse matter, protecting chickens and pigeons from their attacks and rat-proofing granaries and store-houses of all kinds.

Their nests can be broken up by tearing up floors, passage-ways, cellars, piles of rubbish, lumber, scrap-iron and other refuges, and destroying old, deserted buildings and shacks, followed by the free use of cement or concrete to render the basements, cellars, and walls of all buildings absolutely rat-proof. Strong galvanized-wire netting of one-half-inch mesh is also an effective obstacle to their entrance. With the disappearance of rats, rat-fleas also vanish from a community.

The rat can be, to use an expressive recent phrase, "built out of existence," as is being done in San Francisco, but only a few people have sufficient intelligence and public spirit to do their part in this movement except under compulsion. Therefore we must have laws governing the careless harboring of the rat.

A city garbage dump always affords

food for rats and on that account alone should never be allowed to exist. Garbage incinerators should be universally established. (Penna. Depart. of Health Bull., May, 1910).

Since plague is a disease of commerce and likewise a disease of rats, and since rats travel the world over in ships, it is incumbent on those who are charged with the protection of the health of marine ports to **kill rats in ships**. Periodical fumigation is recommended, by **sulphur dioxide, carbon dioxide, carbon monoxide, or funnel gases**. An international agreement is suggested. Rucker (Jour. Amer. Med. Assoc., July 27, 1912).

In the recent epidemic of human plague in Porto Rico, 55 cases, all of the bubonic type, were recorded, with a mortality of 65 per cent. Although flea infestation was very low, the infestation of rats by the chicken flea in San Juan is noteworthy. R. H. Creel (Jour. Amer. Med. Assoc., May 17, 1913).

Some writers have reported negative results but the writer's examination of 2111 field rats showed fleas on 565, and that more than half of the fleas were of the cheopis species. He found also that the field rats get this flea from the house rats, but that this species dies off out of doors when inclement weather arrives. Otten (Meded. v. d. Burg. Geneesk. Dienst, Batavia, 6, 1917).

The essential feature of an anti-plague campaign should be the **extermination of rodents**. In rat surveys for the detection of plague infection, the U. S. Public Health Service advises the examination of at least 1000 rats for every 10,000 of the human population, and a survey should be made so that the most promising locations for trapping shall be known. McCoy and Chapin (Public Health Rep., xxxv, 1647, 1920).

A mixture containing **tobacco and sulphur** may be used for dusting the floor and rat holes. Dead rats should be covered with **kerosene** and burned. The furniture, bedding, etc., should be put in the sun, and the room swept

and some **sulphur** burned in it. All rat holes, old or fresh, in a house should be filled with cloth soaked in **tar**. Grain should not be stored near a dwelling. During an epidemic all should wear **boots** or **puttees** with trousers. Rats may also be largely reduced and frightened away by poisoning. The best poison is **barium carbonate**, $\frac{1}{4}$ pound made into a dough, and divided into 1000 pills, a few of which should be put near each hole. Children and dogs must be kept away from these pills. Gupta (Indian Med. Rec., June, 1923).

Experience has seemed to show that in *bubonic* plague the risk of transmission from the patients themselves is much less than was formerly supposed, new cases resulting rather from the activities of infected rat-fleas. Nevertheless, prompt **isolation** of the sick and of those who have been in **close contact** with the disease is advisable, and likewise the **disinfection** of all **premises** in which cases occur, and of **latrines** (since the bacilli pass out in the excreta). **Direct sunlight** kills the bacillus in two to four hours. As a factor of secondary importance in the spread of the disease McCoy mentions convalescent patients, especially those with unhealed ulcers from buboes, and persons who have been exposed but not yet developed the disease. **Fumigation** against rodents and insects should be carried out in houses known to harbor infected rats or in which plague cases have occurred. **Garbage** should be so enclosed as to exclude rats.

The belief that infection of doctors, nurses, attendants, etc., in plague hospitals is caused only by large or visible particles of sputum expectorated by the patient is erroneous. It follows that the **wearing of masks** and the proper **covering** of any surface of

the skin where fresh **abrasions** are present are important personal prophylactic measures in *pneumonic* plague. It also follows that the **eyes** should be **protected** against this manner of conjunctival infection by proper **glasses**. Articles of **clothing worn in the wards** should immediately be **sterilized after removal**, since, even though no particles of sputum may be visible on them, plague bacilli may be present. Pneumonic plague cases should be placed in a separate hospital. The **sputum** should be **disinfected**.

The **cotton or gauze mask**, if properly worn, is certainly efficacious. The author found plague sputum very resistant to antiseptics; **concentrated antiseptic solutions** and prolonged exposure are required. To disinfect plague houses, he advocates **burning crude sulphur** in an earthen pot after spraying the walls and floor with water. Tuck (Lancet, Oct. 22, 1921).

As to the best methods of **disinfection**, moist heat—*i.e.*, **steam**—has been found the most efficacious. Among the best chemical agents are **lysol**, and **chloride of lime** in 1 per cent. solution. **Phenol** is useless in less than 5 per cent. strength.

Active Immunity.—Several methods of producing active immunity have been proposed. **Haffkine**, working in India, in 1907, proposed his well-known **prophylactic**. This consists of a bouillon culture of the pest bacilli, killed by heat and carbolized so as to represent a 0.5 per cent. solution of phenol. The usual dose (given subcutaneously) ranges from 2 to 3.5 c.c., but in special cases as much as 20 c.c. has been given. As a rule, there follow slight fever, malaise with local swelling, and edema for 24 or 48 hours. Eight or ten days

later, a second dose may be given. When repeated, the prophylactic gives relative immunity for a few months.

While **vaccine** is probably of some value, it is not capable of controlling an outbreak of plague. The evidence on the prophylactic value of **serum** is not conclusive and the agent need not be seriously considered in this connection. McCoy and Chapin (Public Health Rep., xxxv, 1647, 1920).

Report from India of favorable results with Haffkine's vaccine, 6000 uninoculated persons showing 76 attacks and 47 deaths, as against 17 attacks and 2 deaths among 4831 inoculated subjects. Beals (Jour. Amer. Med. Assoc., Oct. 2, 1920).

During a plague epidemic, the writer inoculated 503 persons with a **plague vaccine** made in Bombay; dose, 4 c.c. Out of the 503, 9 persons were attacked with plague and 7 recovered. Gupta (Indian Med. Rec., June, 1923).

A 12 years' test with **Haffkine's vaccine** in Java proved rather disappointing, the mortality being scarcely reduced 50 per cent. and the actual morbidity much less. Fumigation and disinfection were futile, **rat-proof houses** and **rat extermination** proving the only certain remedies. Otten (Netherl. Ind. Civil Med. Serv. Rep., pp. 115-248, 1924).

Passive immunization with **serum** from artificially immunized animals has been used prophylactically and therapeutically. Such an immunity is said to last but a few days. Where there is marked risk of infection, both vaccine and serum may be given.

The writer injected 20 to 40 c.c. of **antiplague serum** into his assistant who had cut himself twice in the hand when making the post-mortem and in all persons who had been in close contact with a case of pneumonic plague not diagnosed before death. No infection occurred. Cherefeddin (Deut. med. Woch., June 20, 1924).

C. E. DE M. SAJOUS,
Philadelphia.

PLEURA, DISEASES OF THE.
—PLEURITIS (PLEURISY).—Inflammation of the pleura, as a *primary* affection, occurs, though rarely. In most cases met with, pleuritis is *secondary* to a general or local disease.

Acute pleuritis occurs in the following forms: *Fibrinous, serofibrinous, seropurulent, purulent, hemorrhagic*,—according to the nature of the pathological process. The following varieties, based on other peculiarities of the disease, are also recognized: *Pulsating, interlobar, and diaphragmatic*. The purulent form of pleuritis will be discussed under CHRONIC PLEURITIS.

ACUTE PLEURITIS.

SYMPTOMS.—When the disease occurs secondarily to some grave disease whose symptoms mask those of the pleurisy, and when it occurs late in such exhausting diseases as carcinoma, nephritis, and tuberculosis, acute pleuritis may be virtually in abeyance, or at least be characterized by a very insidious onset.

In most instances, however, an attack of pleurisy sets in with slight shivering followed by fever and pain in the side. Headache, malaise, and anorexia are usually complained of. In some cases there is an abrupt chill, especially in pneumococcal pleurisy, which may closely simulate pneumonia. In children the chill is usually replaced by vomiting, sometimes by a convulsion.

Severe, stabbing pain is the most distressing and constant symptom; it usually occurs in the neighborhood of the nipple or in the axillary region. It is apt to be sudden after exposure to traumatism or when the disease develops in the course of pulmonary tuberculosis. The pain may, however, be referred to the back or to any part of

the abdomen. So severe and circumscribed has it been in the abdomen that a diagnosis of appendicitis has been made and an operation performed. The pain ordinarily is sharp and excruciating, aggravated by respiratory movements and cough. It may occur at the site of the inflammatory process or where the areas of pulmonary expansion are greatest. It may also follow the distribution of the intercostal nerves in the lower thorax and upper surface of the abdomen. In severe cases there is marked tenderness over their course. The pain is aggravated by cough, breathing, change of posture, and pressure. It is usually relieved when the serous effusion becomes sufficient to separate the pleural surfaces—usually the fourth to the seventh day.

In dry pleurisy the pain is increased when the patient bends his body toward the well side; in intercostal neuralgia, on bending toward the affected side (Schepelmann).

There occurs an apparent gastralgia actually due to disturbance of the gastric nerves by inflammatory or cicatricial changes in the pleura. It may be mistaken for gastric ulcer, or termed gastric neurosis if the stomach contents fails to point to ulcer. *Rennen* (*Arch. f. Verd.*, Oct., 1921).

Neither the friction theory nor the muscular theory satisfactorily explains the characteristic inspiratory pain of pleurisy. It is due to tension of the inflamed parietal pleura. *Bray* (*Amer. Rev. of Tub.*, Jan., 1926).

Hard and dry cough is an early symptom, being worse usually in the early stage. It is occasionally attended by slight expectoration of mucus, owing to the associated bronchitis. As it increases the pain, it is repressed as much as possible. Breathing is, as a rule, superficial and rapid owing to the pain caused by deep and slow inspirations. The temperature for the first

week or ten days rarely rises above 101° or 102° F. (38.3° or 38.9° C.); in the pneumonic type it may be as high as in pneumonia, with an incomplete crisis followed by a second rise. It generally, however, declines by lysis in about ten days, but the fever may persist for weeks, taking on a hectic character, even in serofibrinous cases, suggestive of suppurative exudation. Such cases are probably tuberculous. Exacerbations of the febrile process are not uncommon. Some cases are unattended by appreciable fever.

The pulse is moderately quickened. The pulse-respiration ratio does not undergo the marked change so characteristic of pneumonia. The respiration is also increased on account of the pain and later owing to the bulk of the exudate. The effect of the effusion on the respiration depends much on the rapidity of its accumulation,—a rapid exudation, which may vary from 200 c.c. in the child to 800 c.c. or more in the adult, causing much dyspnea, cyanosis, frequency and smallness of the pulse, while one slowly formed may produce no conscious disturbance so long as the patient is quiet, although the pleural cavity may be moderately distended. Early, the decubitus varies, but when the effusion becomes copious the patient usually lies on the affected side.

PHYSICAL SIGNS.—A sudden "stitch in the side" and fever suggest pleurisy, but a diagnosis is not easy without a study of the physical signs. These depend chiefly on the nature and amount of the exudation. During the first stage, usually termed the "dry" stage, though characterized anatomically by the presence of an exudate on the pleural surface, the movements of the affected side are restrained on account of the pain, the expansion being

somewhat jerky. The patient often lies on the healthy side to avoid pressure on the affected and thus decrease the pain, before effusion has occurred or when it is slight; when it is large, however, he usually lies on the diseased side to allow free expansion of the chest on the unaffected side. When effusion has occurred, the affected side is enlarged, the costal interspaces bulging. The respiratory movements of the chest and also those of the diaphragm on the side of the effusion are restrained or arrested. Fluoroscopic examination shows this plainly. Owing to lessened expansion of the lung and the considerable amount of plastic exudation, there may be somewhat diminished resonance.

Palpation elicits, in this stage, a fremitus, due to friction of the pleural surfaces. Percussion is as a rule negative, though it may reveal an unusual degree of sensitiveness of the tissues over the affected region. On auscultation the breath-sounds are weak or even absent. Friction-rub may be heard and is the diagnostic sign. When well defined it is heard as a to-and-fro sound in inspiration and expiration. It may be heard in deep inspiration only. Usually in children and not rarely in adults it is absent. It may be heard only over small areas,—in the inframammary or axillary region,—and is therefore liable to be overlooked. It consists of a succession of superficial creaking or rubbing sounds, but may resemble a crackling r  le. It lasts but a few hours in cases of rapid effusion. In pleurisy in the neighborhood of the heart a friction-sound of cardiac rhythm may simulate pericardial friction. The inflammatory process may undergo resolution at this time or proceed to the stage of effusion.

The physical signs of the stage of effusion vary with the volume of fluid which the pleural cavity contains. If the effusion separates the pleural surfaces the pain is relieved and the chest-movements become more free. If the effusion is slight, there may be no sign or the level of the fluid may be detected, the patient sitting up, by a vesiculotympany beginning with that level. As the fluid increases in quantity the intercostal depressions become widened and obliterated, giving the chest a smooth, rounded appearance with increase of the anteroposterior diameter. The chest movements are then lessened both transversely and vertically. In large effusions the mediastinum is displaced toward the sound side, especially so in effusions into the left pleura. The position of the cardiac impulse is an excellent index of the degree of mediastinal displacement, and therefore of the amount of pleural effusion. It may appear at the left axillary line or as far to the right as the right mammary line. The downward displacement of the diaphragm is measured by the position of the liver and spleen, the lower borders of which may be at or below the umbilical line.

Palpation at this stage elicits diminution of the vocal fremitus over the effusion, but an important sign of the latter is the flat note and the increased, or "board-like," resistance over the whole area of the effusion. This loss of resonance and elasticity is due chiefly to the liquid in the pleural cavity, but partly also to the collapsed state of the lung beneath the fluid. The dullness extends from the base upward, being usually higher behind than in front.

The spinalis-muscle sign of pleurisy is analogous to the rigidity of the abdominal walls in case of trouble be-

low. There is a reflex contraction of the spinalis muscle tending to immobilize the diseased thorax and pleura. As the patient stands perfectly straight, the contracted muscle forms a prominent mass, hard and larger than the normal outline of the muscle. This occurs, in other conditions, but these can be easily excluded when examining for pleurisy. The spinalis muscles are liable to be unusually developed in porters or in case of much lordosis and the sign may accompany kidney and liver disease, peritonitis, etc. Ramond (*Presse méd.*, May 15, 1913).

When the effusion rises higher than the angle of the scapula the lung will have relaxed to such a degree as to give a tympanitic note above the nipple: the skodaic resonance. Posteriorly the note is usually somewhat impaired far up the back. The level of the fluid is usually altered by a change of position of the patient. On this point, however, different observers report different results. Possibly in moderate effusions the fluid changes gradually with change of position of the patient if there are no adhesions. In some cases, in which the effusion has formed in the recumbent position, the area of flatness corresponds with the surface of the lower lobe of the lung; but in some of these the exudate is almost wholly fibrinous. The lower limit of flatness on the right side passes into and cannot be distinguished from liver-dullness; on the left extends to and, in large effusions, it obliterates stomach-resonance: Traube's semilunar space (McPhedran). Ellis has called attention to an S-like curve in the line of demarcation which he regards as characteristic. When the effusion is sufficient to fill the pleural cavity, no change of level can be detected by changing the patient's position. The

skodaic resonance and, sometimes, the "cracked pot" sound are discernible.

In the diagnosis by X-ray, the location of fluid in serofibrinous pleurisy depends upon the position assumed most constantly by patient during acute stage, and exudates of this type are but slightly, if at all, mobile. These facts are of assistance in the differentiation of serofibrinous from other varieties of effusion. Engelbach and Carman (*Amer. Jour. Med. Sci.*, Dec., 1911).

The writer urges the importance of percussion in the axilla and infra-axillary region for the early recognition of certain pleural disorders. From experience in over 1000 cases, he asserts that, given posterior thoracic dullness, axillary or even infra-axillary dullness should direct attention to the possibility of an effusion or adhesive process in the pleura. In acute or subacute chest affections, dullness in the axilla, *i.e.*, above the transverse nipple line, indicates in over three-fourths of all cases the presence of fluid, especially when the level of axillary dullness is higher than that posteriorly.

Infra-axillary dullness alone indicates, under similar conditions, the presence of fluid in about one-half of all cases.

Observing axillary dullness should always incite the practitioner to the performance of exploratory puncture which, by revealing effusion early, permits of prompt surgical treatment where infection exists. The puncture should be done first in the posterior dull area, then in the axillary and infra-axillary area. G. Mouriquand (*Presse médicale*, March 24, 1919).

Auscultation reveals almost inaudible breathing sounds, though vocal resonance may be normal. Curiously enough, as shown by Baccelli, the whispered voice is transmitted through a serous effusion, but not when it is an accumulation of pus. As the exudation increases, vocal thrill is at first weak-

ened and finally lost over the area of dullness. In rare cases it remains unaffected, especially in children. This may be due to conduction of vibration from the spine along the ribs.

The respiratory sounds are weak or absent below the level of the exudate, but often in children and occasionally in adults tubular breathing is audible all over the dull area, especially if the pleural cavity is so full as to collapse the lung, but not to compress the bronchi. Only a puffing expiration of amphoric quality may be present, or the breath-sounds may be intensely amphoric or cavernous, and may lead to a diagnosis of cavity or pneumothorax.

When the effusion is very large, filling, perhaps, three-fourths of the chest, the resistance to pressure is very marked, the chest movements are still more hampered, and the intercostal spaces may bulge out. The heart is greatly displaced far to the right if the fluid is in the left sac, but it is displaced to the left if the effusion is in the right sac; its sounds, however, are but little, if at all, altered. The vocal fremitus is absent. The percussion note is very flat and skodaic resonance cannot be obtained.

In pleurisy the abdominal muscles contract when palpated lightly below the costal arch when the patient is recumbent. This contracture is never noted in other conditions. Ramond and Deroche (Bull. Soc. méd. des hôp. de Paris, July 23, 1920).

The diagnostic value of the shifting of pleural effusions as observed with the X-rays was shown in 15 out of 17 cases. Observations were made immediately after a change from the erect position to recumbency, and also on raising the pelvis. Lenk (Wien. Arch. f. inn. Med., Nov. 1, 1925).

The Koranyi-Grocco sign, a paravertebral triangular area of dullness on

the side opposite to that of the effusion (described and illustrated under CHEST, SURGICAL DISORDERS OF, *q.v.*), due to extension of the effusion across the vertebral column, is found in practically every case, and disappears on removal of the fluid.

Presence of an effusion may also be detected by means of the coin sign. This is obtained by laying a coin on the front of the chest and striking it with another; the ear placed at the back of the chest hears transmitted to it in some cases a clear metallic sound if a pleural effusion is present.

The *dry friction sign* for the detection of pleural effusion consists in ausculting from the back while the fingers are drawn across the epigastrium over the interposed night gown, stretched tight over the region. This elicits a friction sound on the affected side in case of pleural effusion. Otherwise the rubbing of the fingers is not heard. Mauriac (Jour. de méd. de Bordeaux, July 25, 1920).

Exploring the chest with the aspirator affords a positive means of determining the existence of fluid and its character. If the needle is strictly aseptic and the surface of the chest carefully disinfected, aspiration may be resorted to with impunity. Certain errors have to be guarded against. The exudate may be encapsulated and the needle pass to one side of the cavity. The pus may be too thick to enter a needle unless it is of large caliber; a large needle should, as a rule, be used; it causes but little more distress than a small one. When even a large needle is plugged by the false membrane in piercing it, suction should be cut off and the needle withdrawn, when the plug of purulent fibrin will be found in the needle and confirm the diagnosis. The needle may enter a purulent cavity in the lung re-

sulting from tuberculosis, pneumonia, actinomycosis, a subphrenic abscess, a purulent pericardial exudate, etc.

In this connection a number of complicating conditions or varieties of pleurisy must be borne in mind lest they more or less suddenly modify the clinical picture. They are as follows:—

Tubercular pleurisy, due to invasion of the pleura by the tubercle bacillus in the course of pulmonary tuberculosis, and strictly, therefore, a complication of the latter disease.

Pulsating pleurisy, a form which is practically always purulent. Its characteristic feature is the presence of a heaving pulsation which may be limited to the sternal region, or diffused and most marked in the axillary and scapular regions. In some of the cases the impulse does not occur until perforation of an intercostal space leads to the formation of an abscess-sac beneath the skin, the pulsation being confined to the subcutaneous abscess.

Interlobar pleurisy, in which the opposed surfaces of two lobes of lung adhere. Pus may form a sac between them, forming an abscess which may rupture into a bronchus. It gives rise to hectic fever, and is often the cause of the latter when it follows pneumonia. The X-rays have considerably facilitated the diagnosis of this condition. It is frequently confounded with gangrene of the lung.

Diaphragmatic pleurisy in which the diaphragmatic pleura is involved with the pulmonary pleura or is alone the seat of inflammation. As a rule it is dry, but it may be the seat of a serofibrinous or purulent exudation. It is very painful especially during deglutition and breathing, the patient being thus led to use the upper thorax during respiration. Of diagnostic importance is that

it gives rise to pain in the appendiceal region; also that pressure along the tenth rib where the diaphragm is inserted increases the local pain.

Distribution of the pain toward the abdomen may lead to a diagnosis of disorder in the upper abdomen. Pain and tenderness in the neck region will materially help in the differential diagnosis in inflammation of the central portion of the diaphragm. If the outer edge of the diaphragm be irritated the pain will be referred along the dorsal segment to the abdomen. Dexter (Cleveland Med. Jour., Feb., 1914).

In diaphragmatic pleurisy there is a tender point at the junction of the parasternal line with the prolongation of the 10th rib. Gastric pain may occur through irritation of the vagus in the region of the 5th to the 7th dorsal by toxins or by a contracting pleural condition. Rennen (Arch. f. Verd., Oct., 1921).

Hemorrhagic pleurisy in which the pleural sac is invaded by blood is usually secondary to tuberculosis, cancer, wounds, tapping of the pleura, hemothorax due to rupture of an aneurism or of some local or neighboring vessel from any cause.

Pleurisy presents a very variable course. In the dry stage the inflammation may rapidly subside and recovery take place in a few days. Or, the pain may persist some time and fresh attacks develop in other parts of the pleura. In these the pleurisy is secondary to other affections, chiefly pulmonary tuberculosis.

When there is a serofibrinous effusion the fluid may increase for a week or ten days; the active process then ceases and absorption sets in, followed by a rapid recovery. Or absorption may not begin until after the lapse of a stationary period of indefinite duration.

Recovery is rarely complete in less than a month; when there is consider-

able effusion, recovery is greatly delayed, especially if aspiration is required. Absorption rarely begins during the continuance of the fever.

Even though serofibrinous pleurisy is seldom fatal, unless the effusion be excessive; it may persist for months, as in tuberculous cases, notwithstanding repeated aspirations. The effusion causes little discomfort while the patient is at rest, but when the accumulation is at all great, sudden death is liable to occur, especially on exertion. Death may also be caused by thrombosis or embolism of the pulmonary artery, clot in the right ventricle, degeneration of the heart, or edema of the uncompressed lung. Dullness, due to unexpanded lung or to copious fibrinous exudation, often persists after the effusion is absorbed. Local or general retraction of the chest sometimes follows absorption.

DIAGNOSIS.—Pleurisy with effusion may be mistaken for *pneumonia*, but if it is recalled that while in the latter disease there is increased vocal fremitus and resonance, these are decreased in pleurisy, and that in the latter the cough is slight while it is marked in pneumonia, confusion can hardly occur. The earliest symptoms of pleurisy may be latent, however, and thus render the diagnosis very difficult. In the acute dry stage the friction-rub, if present, greatly facilitates recognition of the disease; but if the rub is absent, *pleurodynia* and *intercostal neuralgia* suggest themselves. The presence of fever, however, eliminates these conditions. Careful examination should be made frequently over the area of pain, lest effusion occur and be overlooked.

When later the effusion is abundant, the diagnosis may also be difficult. The diagnosis should then be based upon the enlargement and immobility of the

chest, dullness with loss of elasticity over the dull area, absence of vocal thrill, weakness or absence of respiratory sounds, and the displacement of the cardiac impulse toward the unaffected side. Of these signs the cardiac displacement is the most important.

High-pitched tympanitic resonance below the clavicle is characteristic of fluid below. In moderate effusions these signs may be wanting or indefinite, and the case may closely simulate *pneumonia*. This history of initial chill, the rapid rise of temperature, the dyspnea, the rusty sputum, and the dullness without the wooden character usually serve to identify pneumonia. Again, while in the latter disease there is increased vocal fremitus and resonance, in pleurisy these are decreased. Again, cough is usually slight in the latter disease while in pneumonia it is severe.

Pleurisy in the dry stage may also be mistaken for *intercostal neuralgia*, *periostitis* or *caries*, *gastric ulcer*, and *gastrodynia*, but the presence of fever and other signs serve to identify pleurisy. *Mediastinal tumors* may produce confusion; in the latter the signs are not limited to one side, while signs of pressure on the esophagus and other structures appear sooner or later.

In case of doubt as to the presence of effusion, X-ray examination should be resorted to. The rays are cut off by the dense fluid and the outline of the ribs may be obliterated. The fluoroscope is also helpful. In very obscure cases exploration of the suspected area with the aspirator, with extreme precautions to insure asepsis, may indicate the presence of fluid. Inequality of the pupils is sometimes observed.

A large *pericardial effusion* is sometimes difficult to distinguish from left-sided pleural effusion. But the cardiac

impulse is not displaced to the right in pericardial effusion; the heart is feeble and the impulse weak. In pleurisy the impulse is commonly easily felt unless it is behind the sternum and the heart-sounds are strong. In *large pericardial effusion* there are marked dyspnea and a peculiar cyanotic hue of the general surface.

In the left axilla the percussion-note is skodaic unless obscured by associated pleural effusion. In the latter case removal of the pleural effusion is not followed by due relief and the cardiac impulse is not affected. On the right side *subphrenic abscess* or *hydatid cyst of the liver* may force the diaphragm high in the thorax and be mistaken for pleural effusion. The upper limit of dullness is usually arched and in some cases a friction-rub is present over all parts of the tumor: a sign that should arouse suspicion. Then there are fullness and a feeling of tension in the hypochondrium; the liver is sometimes depressed, but it may be in pleural exudations also. *Hydrothorax* presents all the signs of pleural effusion, and intrathoracic tumors may simulate and often give rise to it (McPhedran).

An *aneurism* may be suggested by a pulsating empyema, but the hectic fever, sweats, leucocytosis, and other indications of the presence of pus and the absence of aneurismal thrill and pressure symptoms serve to identify the condition present.

ETIOLOGY.—Pleurisy may occur at any age including infancy, but males seem more subject to it than females, doubtless owing to the greater exposure to which they are subjected.

Exposure to cold and wet is a prolific cause, especially in debilitated subjects and in those who inherit a proclivity to tuberculous infection, cold

lowering the power of the body to resist pathogenic organisms.

Pleurisy is frequently awakened through extension of a neighboring inflammatory process of the lungs especially, but also in the mediastinum and pericardium. Traumatism and various acute or chronic diseases, such as septicemia, the acute fevers, including typhoid, acute rheumatism, Bright's disease, hepatic cirrhosis, cancer, the second stage of syphilis (Chantemesse); or, independently of any defined syndrome, by various pathogenic organisms, especially the pneumococcus, staphylococcus, and tubercle bacillus. The last is regarded as the most common pathogenic agent in dry pleurisy and in pleurisy with serous effusion.

The pneumococcic cases are frank, sthenic, and benign in tendency. Those due to staphylococci are more insidious and less frank in their symptomatology. The cases due to the typhoid bacillus occur in the course of typhoid fever, are latent in their symptomatology, and are often somewhat hemorrhagic. The tuberculous forms tend to be dry and fibrinous (Fernet).

PATHOLOGY.—The morbid process occurring in the pleura is initiated by hyperemia, and continued in proliferation and desquamation of endothelial cells, as well as in exudation of serum and leucocytes on the surface of the pleura. The pleura loses its polish, partly on account of these changes and partly because of coagulated fibrin from the exudated serum, which forms a thin layer on its surface. Agglutination and more or less permanent adhesion of the opposed areas of inflamed pleural surface take place, and at times this constitutes the sole evidence of the pleural inflammation, serous fluid being either not exuded or at once reabsorbed.

In the more severe cases of this type, the fibrin forms in thick, shaggy masses, of which the layers in contact with the pleura are more or less densely laminated. The fibrinous exudate usually forms more densely on the visceral pleura than the parietal because infection generally takes place from the lung.

When the inflammatory process ceases at this stage it is spoken of as a dry pleurisy (*pleuritis sicca*). The exudate is then partly absorbed and usually in part organized into fibrous tissue, permanent adhesions of the opposed pleural surfaces resulting. It is probable, however, by analogy with peritonitis, that in mild cases all the exudate is absorbed, leaving no adhesions or other traces of inflammation.

In tuberculosis of the pleura the collagenous fibers and layer of elastic fibers resist the extension of the tuberculous process. The blood and lymph vessels within the pleura provide a means by which the products of the inflammation are quickly removed. When, however, the entire thickness of the pleura becomes involved, adhesions are soon formed between the pleura pulmonalis and the pleura costalis. W. S. Miller (*Amer. Rev. of Tub.*, Jan., 1926).

Increased content of the blood in amino-acids and sulphur was observed in pleurisy, tallying with their presence in the effusion itself. Loeper, Decourt and Lesure (*C. r. Soc. de biol.*, Jan. 5, 1926).

In the majority of cases, on the other hand, there is exuded, besides the fibrin, a more or less considerable amount of serous fluid containing fibrinous shreds. The fluid varies in quantity from a few drams to an amount sufficient greatly to distend the chest, *e.g.*, 4 quarts (liters). Unless circumscribed by adhesions, the fluid collects at the lower and posterior part

of the pleural cavity, allowing the lung in this situation to collapse by relieving it of the suction-action of the chest, which normally keeps it distended. The fluid is generally clear, straw-colored, with a faintly green tint, alkaline, and rich in protein material, which sometimes undergoes coagulation upon withdrawal of the fluid from the chest. In addition, the fluid contains large cells from the proliferating endothelium, leucocytes in various stages of transformation into pus-cells and, in some instances, red blood-cells. Urea, uric acid, and sugar may be found in it. The pus-cells are often sufficiently numerous to render the fluid somewhat cloudy, and may be so abundant as to convert it into a seropurulent exudate. The amount of fibrin is also very variable, in some cases forming only a thin layer on the pleura; in others, besides a thick, creamy layer, it forms whitish, curdy masses which collect where the movements of the pleural surfaces in respiration are least marked, especially in its folds and dependent portions. Where leucocytes become so many as to impart the characteristics of pus to the exudate, the condition is known as "empyema" (*q. v.*).

When an effusion fills the pleural sac the lung is compressed into a dark, airless and even bloodless mass at its root, and soon becomes permanently organized and solidified. In the left-sided effusions the heart may be so displaced that cardiac impulse appears near the right nipple and is caused by the impact, not of the apex, but probably of the right auricle and base of the right ventricle. In right-sided effusions the heart is pressed toward the left and the liver may be depressed. Upon organization of the adhesions these organs, with the great vessels, may be per-

manently displaced in various directions, and bronchiectatic cavities may be formed through traction upon the pulmonary tissues.

Serous pleurisy is only exceptionally accompanied by an increase in the number of white corpuscles, and then intermittently. This fact is of diagnostic service. A continuous leucocytosis points to some complication (Morse).

X-ray examination frequently revealed a mediastino-interlobar pleurisy in cases of mediastinal lymph-node tuberculosis. The pleurisy was usually observed to be between the right middle and lower lobes. Fleischner (*Klin. Woch.*, Apr. 30, 1925).

PROGNOSIS.—In nearly all cases in which the fluid exudate remains serous, recovery takes place. The cases of simple pleurisy due to infection, the result of exposure, regularly recover. Death in disease of the pleura can occur: (1) From septic absorption; (2) from extension of disease to other structures, or (3) from interference with the functions of neighboring organs by the great bulk of the exudate.

The liability to sepsis depends on the nature of the infecting organism. Streptococcal infection is the most grave, as even after free drainage has been established general sepsis may supervene. Pneumococcal cases, common in children, usually run a favorable course, a few cases recovering after aspiration alone. Tuberculous cases are, of course, less favorable, the bacilli usually invading other structures, especially the thoracic lymph-nodes. The exudate is often sterile, however, and if the infection remains confined to the pleura these cases also do well.

Analyzing the after-history of 152 cases of pleurisy with effusion, R. C. Cabot found that 80 per cent. of uncomplicated cases

were well at the end of 5 years, and more than half, at the end of 10 years or more. Only 15 per cent. developed demonstrable tuberculosis, and in many of these only after long periods of time after the pleurisy. The type of tuberculosis witnessed was mild. The family history is of great value in determining the prognosis.

Cortical pleuritis is a very common cause of symptoms of acute inflammatory processes in the lower respiratory passages in adults. Most of these cases are of tuberculous origin, in which event the process is usually in the apical and interlobar regions. Non-tuberculous conditions, on the other hand, are more likely to be at the base. Negative laboratory findings do not disprove a tuberculous causation. The immediate outlook is favorable, but the later prognosis depends on the cause. T. Martini and Gourdy (*Semana méd.*, June 4, 1925).

In serofibrinous pleuritis the danger is from the bulk of the fluid and the occurrence of double effusion and of pericarditis. Even large effusions may be absorbed rapidly, but this is more likely to be the case after aspiration of part of the fluid. In children and young adults, acute primary serofibrinous pleuritis is rarely fatal, absorption taking place within a few weeks. In advanced age serous effusions are much less frequent and the prognosis less favorable.

TREATMENT.—In many instances of mild pleurisy, unaccompanied by pronounced symptoms, spontaneous recovery doubtless occurs, possibly with slight adhesions remaining as a consequence. In all more pronounced cases, however, **rest in bed** is necessary, and should be continued until the acute symptoms abate. Even in the mildest appreciable cases this care is required, on account of the frequent tuber-

culous origin of the disease and the irritation of the inflamed pleural surfaces resulting from any increase of respiratory movement. Further slowing of the breathing may be secured by having the patient respire **air as fresh as possible**; the patient may be placed on a sleeping porch with advantage.

In mild cases of dry pleurisy, if pain is troublesome, **hot applications** or mild **counterirritants** may be sufficient to give relief; if pain is more marked or if cough is troublesome, small **blisters** over the seat of pain may be used. Even more rapid in action, however, are **dry** or **wet cups**, which, besides relieving discomfort, may shorten the duration of the disease.

Much relief in moderate as well as in more severe cases may be obtained by **immobilizing the side** by the application of overlapping **strips of adhesive plaster** extending from the spine to the sternum, the first strip being applied at the end of a forced expiration.

Ice-bags applied over the affected area and kept in place by a bandage often give marked relief, though **heat**, applied in the form of a **hot-water bag** or **compress**, is more agreeable to many. Capps uses **strips of linen** two inches wide and twelve inches long, **laid on ice**, applied parallel to the **ribs**, and frequently renewed.

In cases with severe pain 6 to 10 **leeches** may be applied instead if the patient is in ordinary robust health; but they should not be used in the young or the aged. The bleeding may be encouraged by hot fomentations or a large poultice. After it has ceased, a firm bandage to restrain the movements of the chest may give

relief, or even the adhesive plasters may be used.

In the more severe cases a hypodermic injection of **morphine**, later repeated if necessary, is the most effective means of obtaining relief. If even this measure fails, **venesection** may be resorted to.

Where cough is troublesome, it may be relieved with small doses of **morphine** or $\frac{1}{4}$ -grain (0.015 Gm.) doses of **codeine**. For high fever, **sponging** with **water as cool as can be borne** or with **alcohol and water** usually suffices. **Sodium salicylate** or **acetylsalicylic acid** may also prove useful in reducing temperature.

When there is moderate sero-fibrinous effusion, in addition to the above means, purging may be tried in the average fairly robust patients. For this purpose $\frac{1}{2}$ ounce (15 c.c.) or more of saturated solution of **magnesium sulphate** may be given in the morning before food is taken, the object being to deplete the blood and thus lead to rapid absorption of serum from the lymph-spaces of the pleural cavity. During the administration of the saline, the food should be dry and the quantity of fluid taken very small. Some advise the administration of **calomel** as well as the saline at the outset, to be followed by daily use of the saline or an **aperient water** until the temperature has returned to normal. **Sodium phosphate**, 2 drams (8 Gm.) in hot water daily, is also appropriate.

At times **salicylates** in full doses induce a marked polyuria and lead to disappearance of the fluid exudate. **Quinine** in average doses has been claimed to exert a favorable effect, and **potassium iodide** has also been recommended. Painting the affected

side with **tincture of iodine** or the application of a succession of small **blisters** is advised and sometimes does good. **Theobromine sodio-salicylate** in 15-grain (1 Gm.) doses three times a day may be given as diuretic with a view to diminishing the pleural effusion. Where evidences of circulatory weakness appear, **digitalis** or **caffeine** may be used.

Autoserotherapy, consisting in the withdrawal of a few to 10 c.c. of the exudate with a needle and syringe and its immediate reinjection under the skin, seems to have given good results in some cases.

In 23 cases of tuberculous pleural effusion, the writer withdrew 5 c.c. (75 minims) of the effusion into an aspirating syringe. The needle was then withdrawn until the point was immediately beneath the skin, when it was introduced deeply into the subcutaneous tissue, and the patient received the entire 5 c.c. subcutaneously. In 8 cases there was complete absorption within 2 weeks, while the treatment failed in 15. Lyter (*Am. Jour. Med. Sci.*, Nov., 1918).

Autoserotherapy recommended, on the basis of observations in 4 cases, where a pleural effusion persists in spite of **rest in bed** and puncture. In a case described the writer collected some of the effusion in a sterile test-tube, placed it on ice for several days, added phenol to make a 0.25 per cent. solution, kept the fluid on ice again for a week, made certain it was sterile by cultural tests, and then injected 1 c.c. (16 minims) of it into the muscles of the back for 13 successive days. No reaction was produced, but the effusion underwent rapid reabsorption thereafter. V. Petersen (*Ugeskr. f. Laeger*, Jan. 11, 1923).

Authors disagree concerning the value of **autoserotherapy**, i.e., reinjection of fluid removed from the chest during exudative pleurisy, but the writer observed a case which left no room for doubt. The first reinjection of serum

brought no improvement, the chest being again filled with fluid 3 days after the thoracentesis, while the temperature rose to 39.7° C. (103.4° F.). After a second thoracentesis, the author reinjected in the gluteal muscles about 20 c.c. of the fluid withdrawn. The temperature dropped the next day to 37.2° C. (98.9° F.), the chest dulness disappeared completely, and the vesicular murmur was restored. From that day the condition improved steadily. T. Pretolani (*Morgagni*, Jan. 27, 1924).

Ingestion of **calcium chloride** in large doses has likewise been recommended.

Blum's advocacy of **calcium chloride** strongly endorsed. It hastens absorption of the effusion and reduces the temperature promptly, while promoting diuresis. In acute pleurisy, it sometimes restored conditions to clinically normal in 24 hours. The dosage required is: 15 Gm. (4 drams) of the dry calcium chloride in 24 hours, repeated the second day if the fever persists, and reduced by ½ if the fever subsides. It should not be kept up for more than 5 or 6 days, otherwise the general condition suffers, the mineral balance becoming disturbed. It is rendered palatable by giving 2 spoonfuls of the concentrated (30 per cent.) solution in coffee, and drinking a little more coffee afterward. Krummenacher (*Annales de méd.*, Mar., 1923).

Giving large doses, *viz.*, 3 to 8 Gm. (¾ to 2 drams), of **calcium chloride** daily, the writer noted a striking coincidence between the beginning of its use and the disappearance of fever. It acted as a diuretic, but its influence on the effusion was hardly perceptible. Burnand (*Bull. Soc. méd. des hôp. de Paris*, Dec. 21, 1923).

The writer resorts to **salt reduction** in the food, and gives daily 4 teaspoonfuls of the following solution: **Calcium chloride**, 30 Gm. (1 ounce); **potassium acetate**, 60 Gm. (2 ounces), and water, 285 Gm. (9½ ounces). Lunde (*Zeit. f. Tuberk.*, Dec., 1923).

Should absorption not begin at the end of ten days or two weeks, **aspiration of the fluid** is the most rational and effective therapeutic procedure. Rapid rise of the fluid to the third rib in front or the scapular spine behind with rapid respiration, orthopnea, and cyanosis peremptorily indicate intervention. But even where absorption is taking place, though very slowly, aspiration constitutes the treatment of choice. The same applies where dyspnea and cyanosis are the sole unfavorable phenomena noted, or where pronounced displacement of the heart or other nearby organs develops. There should be no delay in aspirating very large serous effusions with evidences of intrathoracic pressure with dyspnea, lest symptoms of heart-failure suddenly set in.

Injection of air into the pleural cavity recommended after every **puncture** for serofibrinous pleurisy. It prevents adhesions and other secondary difficulties. Of 86 cases punctured without air injection, 84 per cent. had marked secondary trouble a few months or weeks later, while of 50 cases with air injection, 82 per cent. recovered without adhesions. In the 18 per cent. which did show adhesions, the disease had been of long standing. Fever and other evidences of infection rapidly disappeared after air injection; 17 out of 50 cases required but 1 injection. Weil (Bull. de l'Acad. de méd., lxxxi, 846, 1919).

The writer never noted untoward effects when, after tapping the effusion in 40 cases he allowed air to enter the pleura through the trocar. The disease was often shortened; thick adhesions seldom formed, and the tendency to recurrence seemed checked. Hoogslag (Nederl. Tijd. v. Geneesk., May 18, 1918).

During the pyrexial period **aspiration** is said to be very liable to

be followed by a reaccumulation of the exudate. Reappearance of fever after it has disappeared from the acute stage is strongly suggestive of pus, which should be promptly evacuated (see section on EMPYEMA, in this article).

Where the diagnosis of pleural effusion and the location of the exudate are not reasonably certain, **exploratory puncture** with a 5- or 10-c.c. Luer syringe and large-sized hypodermic needle is frequently carried out as a preliminary to evacuative aspiration.

Frequently the withdrawal of a comparatively small quantity of even a very large effusion is followed by rapid absorption of the remainder. This is probably due to the removal of excessive pressure from the pleural lymph-vessels, allowing of their dilatation and of a free flow of lymph.

In small effusions the puncture with the aspirator needle must, of course, be made over the seat of effusion. When the effusion is large, so that the pleural cavity is nearly full, the best place for puncture is outside the angle of the scapula or in the middle line of the axilla, on a line with, or a little below, the nipple; *i.e.*, at about the seventh intercostal space, as the intercostal spaces are here wide and the chest wall thin. These places are safe unless the lung is adherent. In encapsulated and interlobar effusions, the signs elicited by auscultation and percussion must be taken as indications of the proper site of puncture. An overlying area of tenderness may also be of value in this connection.

The procedure of aspiration should be carried out with strict aseptic precautions. The skin surface to be

punctured having been cleansed with alcohol and tincture of iodine, a sharp, sterile trocar and blunt cannula—or a large hollow needle—are introduced at the site of election, preferably after making a small skin incision under ethyl chloride, infiltration, or ice and salt anesthesia. A very useful disinfectant and anodyne, to be used instead of iodine, is a saturated solution of phenol, applied over an area the size of a silver dollar and washed off twenty seconds later with alcohol (Capps). The trocar or needle should be introduced just above the upper border of a rib, in order to avoid wounding of the intercostal artery. The operation may be facilitated if the hand of the side to be tapped is placed over the opposite shoulder. After the incision it is well to introduce the needle with a sudden thrust, so that it may penetrate the layer of fibrin on the costal pleura and not carry it away from the chest wall. Suction may be obtained either with the Potain aspirator, provided with a pump; by setting fire to a little alcohol in a 2-liter (quart) bottle, to which the aspiration tube is then attached, or by means of a simple rubber siphonage tube leading to a receptacle containing water, which can be raised or lowered at will. The degree of suction applied should be sufficient only to maintain a gentle flow of fluid.

The latter measure should be discontinued as soon as the suction causes frequent cough, pain in the chest, or the appearance of blood in the fluid withdrawn. Occasionally a case is met with in which the fluid will not flow because the lung is so bound down that it cannot expand.

In such one must be content with the few ounces that can be withdrawn.

When conditions demand relief from the effusion at once, we can generally assume that the lung is not adherent to the pleura and can thus venture to use a simple **puncture** needle instead of a trocar. To regulate the pressure, and thus avoid doing harm by abrupt changes of pressure, the writer runs the needle into a fish bladder, when a suitable apparatus is not at hand. The fish bladder gives to the pressure and does not permit air to be sucked into the needle. The same purpose is accomplished by a tube on the end of the needle, the other end submerged in a vessel with salt solution. By raising and lowering the vessel the pressure in the needle can be regulated and the tube clamped with a clothes-pin. Grober (*Deut. med. Woch.*, July 16, 1914).

Paracentesis is usually well tolerated by the patient, though at times a tendency to syncope develops. Preliminary administration of an ounce (30 c.c.) of whisky is advised to guard against this tendency. Where syncope develops, the operation should be discontinued. Sudden death during a tapping has in rare instances occurred, though less frequently, according to Tyson, than in untapped cases.

The writer used injections of 1:1000 **epinephrin hydrochloride** solution into the pleural cavity in 20 cases, with constantly very favorable results. The amount injected was at first 0.3 c.c. (5 minims), and on the four or five succeeding days 0.2 c.c. (3.3 minims), in saline. Temperature began to descend on the third day, and the effusion underwent rapid absorption. Wedensky (*Pediatrics*, No. 6, 1913; *Semaine méd.*, Sept. 10, 1913).

The sitting posture is generally adopted during thoracentesis. Capps, however, prefers the recumbent posi-

tion, with the shoulders raised by pillows, or a lateral position, except in cases with marked dyspnea, asthma, or uncompensated cardiac disease. If, during the procedure, violent and spasmodic cough appears, or a sense of constriction, faintness, or great pain is experienced, the operation should be interrupted, to be resumed tentatively a little later when the symptoms have passed off.

The amount of fluid to be evacuated varies, in general, with the volume of the effusion. In large effusions, 1500 c.c. or even more may be evacuated in the course of half an hour, if no immediate untoward effects are noticed. Some have advised against withdrawing any more fluid than is required to relieve all the preëxisting symptoms. The older the subject and the greater the duration of the effusion, the greater the caution to be exercised in removing large amounts. In the great majority of cases, a single paracentesis proves sufficient; in the remainder, one, or frequently more than one, repetition of the procedure is required before reaccumulation ceases.

Pleurisy is always to be treated as a serious disease, particularly if suspected to be of tuberculous origin. The chances with primary serofibrinous effusion are about 3 or 4 in 10 that pulmonary or other tuberculosis will appear within six or seven years (Lord). Efforts should be made to secure complete absorption of the exudation and full re-expansion of the lung, if necessary by repeated tapplings. The patient should preferably be kept in bed for a month after effusion and other manifestations have ceased, and only gradually thereafter be allowed to resume activity. Nutrition should be maintained at the highest

possible level by **favorable sanitary conditions**, an abundant supply of **good food**, and such medication as the special features of the case call for. **Chilling of the body**, as well as **violent exercise and fatigue**, must be **avoided** for some time after subsidence of the acute process.

Gradually increasing doses of **creosote** have appeared beneficial in some cases. **Out-of-door life** is as necessary as in other forms of tuberculosis. If chest retraction is progressive after disappearance of the fluid, **residence in high altitudes** may be desirable.

The systematic practice of **deep inspiration followed by slow, obstructed expiration** has been recommended by McPhedran. For children this may be effected by blowing bubbles or by having 2 large bottles, 1 empty and the other filled with water, connected by tubing and a suitable tube with mouth-piece inserted into the full bottle, the child being encouraged to force the water over into the empty bottle by blowing into the full one. This may be done several times a day.

Pneumographic tracings utilized to prove the value of **deep respiration in breaking up pleural adhesions**. D'Hencqueville (*Presse méd.*, Feb. 26, 1921).

In pleurisy, gradual distention of the compressed lung by means of the **spiroscope** forces absorption of the effusion. Pescher (*Paris méd.*, Apr. 25, 1925).

Artificially induced pneumothorax by means of **oxygen, nitrogen** or **filtered air** has been used with success in some cases.

In dry pleurisy, the writer reserves **artificial pneumothorax** for cases with refractory severe pain lasting for weeks. Serous and serofibrinous pleurisy should be similarly treated if there is recurrence following removal

of fluid. Puncture should be omitted only in cases with scanty exudate and a tendency to spontaneous recovery. In all others the exudate should be removed as soon as possible, though a delay of 1 or 2 weeks is indicated in cases with fresh, progressive pleuritis. Puncture without air insufflation should be carried out in the removal of recent exudates, in puncture to save life, or where there are large quantities of fluid. Puncture with air insufflation may be carried out in cases of longer standing in which there is a question as to the complete removal of the fluid. The gas may either be introduced with the pneumothorax apparatus or air simply allowed to enter the pleura through the trocar; the former procedure is preferable because the amount introduced can be accurately gauged. Cobet (Med. Klin., Feb. 2, 1922).

The writer observed an increase of chloride elimination during absorption of pleural effusions. He advocates a salt-free diet. H. Deist (Deut. med. Woch., May 9, 1924).

CHRONIC PLEURITIS.

Under this term are included the forms of pleurisy in which the duration of the affection is greater than a few weeks. These may be classified into the *exudative*, including *chronic non-suppurative pleuritis* and *chronic suppurative pleuritis* (empyema), and the *plastic* or *dry*, occurring in the *primary* and *secondary* varieties.

X-ray treatment of chronic pleurisy without effusion is highly recommended. The pain is relieved after the 1st exposure, but 2 or 3 more are required to prevent a relapse. In 2 cases the irradiation was applied to the painful region at a ^{cutaneous} distance of 30 cm., with 3 mm. of aluminum filter. The dose was $\frac{1}{2}$ skin dose, once a week, repeated 3 or 4 times. Where there is a complicating pulmonary lesion, irradiation should not be used. Bársony and Holló (Zeit. f. Tuberk., June, 1924).

CHRONIC NON-SUPPURATIVE PLEURITIS.—This may follow acute serofibrinous pleurisy. Paracentesis may be performed from time to time, but the fluid reaccumulates. The exudate continues to be serous, with, in some cases, a large deposit of gelatinous material on the pleural surfaces. After months or even years some retraction of the chest may take place, showing that the fluid has been partly absorbed. There may have been no symptoms except some dyspnea on exertion, lighter occupations being pursued with comfort.

In other cases the affection is latent from the beginning (*latent pleurisy*). The onset is not marked by any symptoms that attract attention. With the accumulation of fluid, dyspnea appears on severe exertion and becomes more easily provoked as the fluid increases. Inquiry into the history usually reveals more symptoms than the patient was aware of. Clubbing of the fingers and toes may be marked.

Probably the great majority of these cases are of tuberculous origin, the condition being analogous to cases of peritonitis with similar pathological changes and a similar history.

TREATMENT.—**Aspiration** should be resorted to in these cases and repeated as often as the fluid reaccumulates, as much of the fluid being removed as will flow without distress to the patient. **Autoserotherapy** may be tried. If reaccumulation occurs after the third evacuation, **continuous siphon drainage**, using a cannula of such size that a small drainage-tube can be slipped through it, may be employed for a time. Or, when it seems useless to repeat aspiration,

active counterirritation to the chest may be continued and short courses of alterative drugs given. Every means possible to improve the general health should be adopted, as an out-of-door life, respiratory exercises, nutritious diet, and a change of residence. A sojourn in high altitudes does good in some cases, being followed by re-expansion of the lung.

If the exudation becomes purulent, it is drained (see following section).

CHRONIC SUPPURATIVE PLEURITIS (Empyema; Pyothorax).—This is manifested as an accumulation of pus in the pleural cavity. Among the subsidiary varieties of empyema are the following: Pulsating, multilocular, double (bilateral), interlobar, and tuberculous. The first three of these terms are self-explanatory. Interlobar (often erroneously termed interlobular) empyemas follow inflammation of the pleural surfaces separating adjacent pulmonary lobes, and, though not primarily abscesses of the lung, merge into the latter condition when not circumscribed by adhesions or evacuated early. Tuberculous empyema occurs in scrofulous subjects and is often localized, with caseous masses.

SYMPTOMS.—In most cases of empyema there is a history of exposure to dampness or overheating. A chill comes on, ^{is} followed by fever and severe pain in the side, ^{is} frequently followed by a more or less complete subsidence of the symptoms. In a few days dyspnea and unusual restlessness call the attention of the patient again to his chest. In some cases the disease is identical in its onset and course with the ordinary acute serofibrinous pleuritis, to which it becomes superadded as a complica-

tion. In a month or two the patient is likely to have become emaciated, pale, weak, and morose, with a short, loose cough suggestive of tuberculosis—a suspicion apparently confirmed when night-sweats are noticed. The aspect is that of extreme exhaustion. Pain in the affected side may be one of the first symptoms; but the most marked of these are dyspnea and general prostration due to the absorption of pus. The skin may be clammy and bathed in a cold perspiration. The respiration is about 40 to the minute; the temperature from 103° to 105° F. (39.4° to 40.5° C.). The blood shows a polymorphonuclear leucocytosis.

PHYSICAL SIGNS.—These are, on the whole, the same as those in acute non-suppurative pleurisy, consisting of dullness or flatness on percussion of the affected side, together with disappearance of vocal fremitus. The respiratory sounds are nullified, though the bronchial murmur of a preceding pneumonia may be perceptible just above the pus-filled area. The following differences between the signs of a serous and a purulent pleural effusion are of significance: (1) the intercostal spaces are more likely to protrude in the latter condition, owing to infiltration and consequent paresis of the intercostal muscles; (2) whispered pectoriloquy is less transmitted through a purulent than a serous exudation (Baccelli's sign); (3) a localized area of edema over the effusion almost certainly points to its purulent nature, and (4) in children there may be an extraordinary enlargement of the affected side of the chest (Kelly).

Characteristic of cases of empyema supervening upon lobar pneumonia,

according to Hale White, is an apyrexial interval of one to five, usually two or three, days between the fall by crisis in pneumonia and the rise of incipient empyema. The temperature now rises from 2° to 4° or 5° F. above normal in the evening, and 1° or 2° in the morning, this condition continuing until the pus is evacuated. To be sure, in some cases there is no, or only an incomplete, apyrexial interval, the fever of pneumonia merging into that of empyema.

In cases of empyema where the accumulation of pus is only slight, but little more than dyspnea and a rise of temperature are seen.

The natural termination in a case of empyema not recognized and treated (unless death takes place from sepsis and exhaustion) is rupture at the points of least resistance, viz., internally, above into the bronchi or trachea, or, externally, at the free spots of Marshall or of Traube. The point on the right flank which is comparatively free from muscular covering is called the free spot of Marshall, while that on the left side is the region of Traube. Cox has reported a case in which spontaneous evacuation took place in front between the sixth and seventh ribs, with recovery. The pus may discharge through the intercostal spaces, but fail to reach the surface at that point on account of the muscles; it then burrows beneath them. In one case it escaped at the umbilicus.

DIAGNOSIS.—The diagnosis may be made from the extreme dullness and lack of respiratory sounds, combined with persistent temperature elevation. Recurring chills, fever, and sweats, with local edema of the chest wall and polymorphonuclear

leucocytosis, conclusively indicate purulency of an effusion. If doubt arises, an exploratory puncture, with cytological and bacteriological examination of the fluid obtained, is advisable.

At times cases of empyema may be confounded with ordinary *intramural abscesses*, as when they occur near the axilla, and are incised. *Pulmonary abscess* and *subdiaphragmatic abscess* are other possibly confusing conditions to be borne in mind.

The so-called "pulsating empyema," transmitting the cardiac systole to the chest wall between the second and fourth ribs anteriorly, the third and fifth ribs in the axilla, or over an extensive area, is not likely to be confounded with an aneurism.

In children the course of empyema is often brief and critical, some cases succumbing within forty-eight hours. The signs in these cases are the same as in *pneumonia*, and exploratory puncture is essential if a correct diagnosis is to be made.

ETIOLOGY.—In some instances the etiology of empyema is that of acute pleurisy, in which it originates. The clear exudate of the former, perhaps because of secondary infection from without (possibly through thoracentesis), becomes progressively more cloudy and richer in cells until the characteristics of pus have been assumed. In other cases the condition is purulent at the outset or becomes so very soon. Among the etiological conditions in these cases are: infected chest wounds, infective disease of the thoracic bony cage, mediastinum, or abdominal viscera, septicopyemia, rupture of tuberculous lung cavities or bone abscesses (ribs or vertebræ) into the pleura, and general infections

such as scarlet fever, typhoid fever, measles, etc.

In adults the micro-organisms usually responsible are the streptococci or staphylococci, less frequently the pneumococcus, the colon bacillus, the tubercle bacillus, and the typhoid bacillus. In children, in whom very many instances of empyema follow pneumonia, the commonest organism is the pneumococcus. In infancy, practically all pleural effusions are purulent from the outset or soon become so. Hartwell found in children that pneumonia caused 50 per cent. of the cases of empyema; the pneumococcus was found in one-half the instances where the pus was examined bacteriologically, and the streptococcus in about one-fourth. Blaker found the pneumococcus in 65 out of 69 cases.

PATHOLOGY.—In the incipient cases, in which the exudate is as yet only seropurulent rather than purulent, the pathological changes in the pleura are those of serofibrinous pleurisy, though more marked, consisting of pronounced thickening of the membrane, appearance of a dense fibrinopurulent covering layer, and a pronounced infiltration with polymorphonuclear leucocytes. When true purulency has supervened the exudate is thicker, especially in pneumococcic cases, and may then separate into two layers, the lower of thick pus and the upper of thin, greenish serum.

In some neglected cases, or cases following abscess or gangrene of the lung, stab wounds, or cancer of the esophagus, the fluid may become foul-smelling (*putrid or fetid pleurisy*).

PROGNOSIS.—While in untreated or poorly treated empyema the prognosis is unfavorable, cases seen early

terminate favorably under proper treatment. Even in spontaneous rupture externally or into the lung recovery may eventually occur, though the fistula is likely to persist for some time. The nature of the causative bacterium is of some significance in the prognosis, infection with the pneumococcus being, on the whole, less serious and persistent than with the streptococcus. Tuberculous pleuritis is a chronic process usually terminating fatally, lasting for years until tuberculosis or an intercurrent affection carries off the patient, or until he gradually succumbs to prolonged hectic amyloid disease and asthenia.

The readiness with which the compressed or retracted lung returns to fill the cavity when drainage has been established is also a measure of the prognostic tendency of the case as to ease of repair and prompt return to normal health.

Danger to life in empyema is attendant chiefly on complications such as pericarditis, peritonitis, and septicemia. In all cases the most serious residual consequence of the affection is deformity, and in children lateral spinal curvature is likely to occur where there has been long-continued discharge from the pus-cavity.

While in most cases of empyema the cavity closes under treatment, even when healing has been delayed many months, recurrence may occur at any time from faulty drainage. Pyemia and septicemia result from putrid empyema, and generally military tuberculosis may follow a localized tuberculous pleurisy which becomes purulent. Rupture into the bronchi, trachea, or lungs, with immediate death from suffocation, or

into the stomach after perforation of the diaphragm, are among the possibilities. According to Cotter the mortality from empyema is about 1 in 7; it is much greater in small children than in those above five years of age.

Comparison by Saltzman and Sievers of the deaths among 128 recovered cases of empyema from 10 to 20 years after their discharge from the hospital with the expected death-rate of the total population at the same age showed a mortality about 20 per cent. above normal among the ex-empyema patients. This rise in mortality began about 5 years after the empyema had been acquired and continued during the following 5 years; 10 years after recovery from empyema it appeared that the expectation of life was practically the same as for the total population. The increased mortality did not seem to depend much, if at all, on tuberculosis.

Records of 3557 sanatorium cases of pulmonary tuberculosis showed only in 4 instances a history of empyema previous to the onset of tuberculosis. Paradoxically, the ultimate prognosis seems to be much worse for a simple serous pleurisy requiring no operative treatment, or merely aspiration, than it is for the patient who recovers from a stormy empyema requiring the intervention of the surgeon. Editorial (Lancet, Dec. 27, 1924).

TREATMENT.—Empyema being sometimes a sequel to non-suppurative pleuritis, a preliminary discussion of its prophylaxis may be considered appropriate.

Blistering and purgation with salines or mercurials, or both, are the measures chiefly relied upon in attempt to arrest the pleural inflammation early enough to avoid suppuration. Gaston strongly urged, especially in children, an early recourse to the following preparation:

℞ *Hydrargyri chloridi mitis*,
Pulveris camphoræ
 āā gr. j (0.06 Gm.).
Pulveris ipecacuanhæ et opii,
Quininæ sulphatis
 āā gr. x (0.6 Gm.).

M. Divide into powders no. x.

Sig.: One powder every two hours.

In adults, larger doses are to be used:—

℞ *Hydrargyri chloridi mitis*,
Pulveris camphoræ
 āā gr. vj (0.4 Gm.).
Pulveris ipecacuanhæ et opii,
Quininæ sulphatis
 āā gr. xxx (2 Gm.).

M. Divide into capsules no. xij.

Sig.: One every two hours in the daytime, and 2 at intervals while awake at night.

This should be followed with two tablespoonfuls of **castor oil** and one teaspoonful of **turpentine**. The bowels are thus emptied, and the turpentine has a beneficial effect upon the bronchial tubes.

In penetrating gunshot or stab wounds of the chest, complete **interruption of communication between the pleural cavity and the outer air** should at once be secured, and careful **antisepsis** instituted whenever the indication exists. Collections of **blood in the pleural cavity** should be early **evacuated by aspiration**.

As soon as the existence of empyema has been discovered, **surgical principles** should be followed in the treatment, pus in the pleural cavity requiring evacuation as in the case of any other abscess. Preliminary aspiration is not necessary, unless the symptoms demand immediate partial relief from pressure on the lung, pending more complete removal a day

or two later. In a few cases of empyema in children, recovery takes place after one or two aspirations; but if there is reaccumulation of pus, provision for free and continuous **drainage** should at once be made. Even in the most desperate cases whatever procedure seems best to procure drainage is definitely indicated, though, where the size of the exudate is so great as to cause cardiac displacement, **gradual evacuation** by aspiration is recommended by some. The latter form of drainage may be effected by the use of a trocar and cannula, followed by insertion through the cannula of a small catheter, held in place by a collodion dressing and attached to a long tube running down to a vessel containing an antiseptic solution. **Continuous drainage** is thus provided by **siphonage**.

Mozingo has reported 45 acute and 93 chronic cases of empyema treated with a mortality of less than 2 per cent. by the following procedure:

Under local or no anesthesia a stab incision 5 mm. long is made in the 8th interspace in the postaxillary line and a trocar and a cannula which will just admit a Carrel tube are inserted. The trocar is then withdrawn, the rubber tube inserted, and the cannula withdrawn. The tube has from 5 to 10 fenestræ 3 mm. in diameter and 1 cm. apart. About 6 in. of tube lie within the chest cavity and about 6 in. outside. It is connected with an aspirator, or **aspiration** is effected by means of a bulb syringe. The ordinary dressing is placed around the tube at the site of puncture, and between aspirations a sterile rubber bulb is placed over the end. In serious cases the cavity is irrigated with **saline solution**, but in ordinary cases **Dakin's solution** is employed. No air is permitted to enter the chest cavity. After aspiration of the secretion, from 50 to 200 c.c. of Dakin's solution are injected, agitated, and aspirated, this process being repeated until the return fluid is clear. A quantity of

Dakin's solution about $\frac{1}{4}$ the original capacity of the cavity is then injected and allowed to remain 5 to 30 minutes. It is then aspirated and the maximum negative pressure reëstablished. This procedure is repeated every 3 to 5 hours by day and once or twice during the night. In subacute cases it is done oftener, and in serious cases, less frequently.

The treatment is begun as soon as fluid is revealed by diagnostic puncture and regardless of the patient's condition. After 4 to 10 days, or when the secretion is sterile or nearly sterile, a 24-hour-old 2 per cent. solution of **liquor formaldehydi** in glycerin is injected once daily. The amounts vary from 5 c.c. in the beginning to 15 c.c. later, and the injection is preceded by the usual treatment with sodium hypochlorite solution. When the smears and cultures are negative the tube is removed.

In 172 cases in children, the writers observed a mortality of 16 per cent. Below 2 years it was 32 per cent.; in pneumococcus infection, 12 per cent., and in streptococcus infection, 27 per cent., while in pure staphylococcus infection there was no mortality. In streptococcus infection **aspiration** or **closed drainage** through a tube would probably supply sufficient drainage and result in lower mortality. In pneumococcus infection a good **opening** is necessary and the lung should be freed routinely. "Collapsed lung" is due to inadequate operation and drainage. Ladd and Cutler (Amer. Jour. Dis. of Childr., June, 1921).

The methods of Mozingo and Moschowitz are rarely successful in the empyemas of infancy, but have very definite value in older children. In 10 cases under 20 months of age treated by repeated simple **aspiration** controlled and guided by fluoroscopic observations, 8 patients made complete recoveries and 2 died. In neither of the latter 2 could the method be held at fault. The first aspiration was always interrupted while the pus still flowed freely. The least number of punctures required was 3. The **bottle-siphon** method is best in vigorous infants over a year of age, and **open drainage** in children of 2 years and up.

Multiple aspiration is best in quite young infants or those weakened by nutritional disturbances or other diseases. Porter and Morris (*Arch. of Ped.*, July, 1923).

In the average case of empyema, however, drainage by incision of the chest wall (**thoracotomy**), with or without **resection of a portion of a rib**, is indicated. The operation may be performed either immediately upon discovery of the purulent nature of the exudate by **paracentesis**, an incision being made precisely where the exploring needle has struck pus, and before it is withdrawn, or a short time later, where the necessary preparations for incision had not been made at the time of thoracentesis. Where the pus-cavity is not a circumscribed one, the opening is generally made in the sixth or the fifth interspace, beginning at the anterior axillary line and extending back two inches or more. According to some, satisfactory results may be had by incising even in the eighth or ninth interspaces in the midaxillary line. Masses of lymph that might interfere with subsequent drainage may be broken down with the fingers. The further conduct of thoracotomy has been described in the article on the CHEST, SURGICAL DISEASES OF, vol. iii, to which the reader is referred (section entitled "Operations on the Chest"). Two rubber drainage-tubes are inserted through the opening made, and the pus is permitted to escape continuously into a thick compress of gauze held loosely over the opening with a binder. Although some air enters the pleural cavity during inspiration, this is not an undesirable event, a slight positive pressure being produced at each expira-

tion which assists in pressing out the pus through the drainage-tubes. As the discharge becomes less in amount and the pleural cavity becomes smaller through healing of the visceral pleura with the parietal, the drainage-tubes require shortening, to prevent contact with the lung and the diaphragm, and may soon be replaced by tubes of smaller diameter, before complete healing takes place. It should be borne in mind that the ordinary drainage-tubes, if allowed to irritate the lung, may themselves be responsible for a continuance of discharge.

Rib resection during thoracotomy is advised as a routine procedure by some. It is especially indicated, however, where the intercostal spaces are so narrow that drainage-tubes can only be maintained with difficulty, as in children and some adults. Removal of a short piece of a single rib is all that is required. Dowd in children excises about $1\frac{1}{2}$ inches of the seventh or eighth rib in the posterior axillary line. Schultz advises careful investigation of the lower and posterior borders of the healthy lung, followed by resection, on the affected side of the rib situated 2 or 3 cm. above this level, near the spinal column. Others select the sixth or fifth rib in the midaxilla (see article on the CHEST, SURGICAL DISEASES OF, vol. iii).

Where the exudate is being thoroughly drained, the amount of discharge decreases in a few days. The temperature should fall after the discharge of pus. Should it not do so, either the drainage is ineffectual or incomplete, or some other pathological condition is present. Recurrence of chills, fever, and sweats and

increasing leucocytosis, after drainage has proven satisfactory for a period, similarly point to obstruction to the outflow of pus requiring correction.

Need of drainage at the most dependent point emphasized. An incision should be made as low down as is safe, and the finger introduced to determine how much lower the incision can be made. Cutting against this finger the lowest possible point can be opened and efficient drainage will be established for both the recumbent and sitting positions. J. F. Binnie (Arch. of Surg., May, 1921).

Value of rest in empyema and lung abscess stressed. In draining, the author uses a **large, short rubber tube**, with some form of **one-way valve** attached to its exposed end. For the first 10 days after rib resection, the **typhoid rest regimen** is instituted, followed by 10 days of sitting up for a while each day. No further privileges are granted until discharge has ceased for 2 weeks. **Fresh air** proved an excellent adjunct, the patients being placed on porches when possible. A **liberal diet, fresh vegetables**, plenty of **water**, and **liquid petrolatum** were other measures used. All of the 7 acute cases and 5 chronic cases recovered except 1 chronic case which died of meningitis after thoracotomy. J. S. Pritchard (Jour. Amer. Med. Assoc., Dec. 30, 1922).

According to some, thoracotomy with rib resection, in fresh empyema, is best delayed until adhesions firm enough to obviate collapse of the lung on opening the chest have formed, evacuation being meanwhile obtained by puncture or the siphon method.

In **irrigation** of the pleural cavity with fluids there is some danger, albeit very slight, of the induction of syncope or complicating conditions such as hemiplegia, convulsions (pleural epilepsy), or even sudden death. Untoward results have followed the use of **water** or **saline solution** as well

as more irritating antiseptic fluids. Through an ulcer on the pleural surface of the lung, fluid may escape into the bronchi and cause shock or suffocation through obstruction of the bronchioles. **Irrigation with potassium permanganate solutions** has been advised by some in cases of putrid empyema. Solutions of other antiseptics, such as **chlorazene**, **iodine**, **boric acid**, and **salicylic acid**, or **Dakin's solution**, are also sometimes used.

The writer succeeded in closing 21 cases of chronic empyema by injection of 2 to 5 per cent. **chlorazene** solutions. The patient is placed on his sound side and the cavity filled with the solution through a funnel inserted into the drainage tube. This position is maintained for 15 or 20 minutes and the solution then drawn off by aspiration. The treatment is repeated 3 or 4 times a day. In cases without tuberculosis or bronchial fistula, results were quickly and easily obtained. W. D. Gatch (Ind. State Med. Assoc. Jour., Sept., 1924).

When evacuation of the pus in the pleural cavity has been secured, a persistent attempt must be made to induce expansion of the involved lung by means of **calisthenic** and **respiratory exercises**,—blowing water from one bottle to another through a narrow tube, etc. Treatment by means of **valve** or **suction apparatus** has at times proven useful.

Instillation of **gentian violet** solution following aspiration has also been recommended.

Aspiration and injection of an aqueous solution of **gentian violet** employed in 18 cases. The writer advocates this method in all acute empyemas and all empyemas in which the fluid is seropurulent. In 3 cases in which the exudate was already organized, small amounts of 0.25 to 1 per

cent. **chlorazene** solutions were injected to dissolve the exudate. By the **gentian violet** method, a certain number of cases will clear up without further treatment; if not, the patient is in a better condition for **surgical drainage** at the proper time. Davis (Amer. Jour. Med. Sci., Nov., 1923).

Of 57 cases treated by injection of 1:1000 **gentian violet** solution, 45 cleared up completely, while 12 were operated on. In none of the failures had the treatment been started at an early stage. No untoward symptoms followed the instillation of this drug. R. H. Major (Wis. Med. Jour., Apr., 1925).

Firm adhesions or fibrosis of the lung in long-standing cases may render the organ incapable of expanding, in spite of adequate drainage. In these cases suppuration will persist as long as the pleural space remains unobliterated. **Surgical treatment** of the overlying chest wall which will permit it to come in contact with the contracted lung is therefore indicated when the condition has remained unchanged about a year and all attempts to sterilize the cavity have failed. Where the intervening space is of moderate size, **Estländer's operation**, which consists in the removal of a considerable section of each of the ribs overlying the cavity, is indicated. The soft tissues of the chest wall are thus permitted to recede into contact with the lung. In inveterate and extensive cases in which even Estländer's operation has not yielded a cure owing to excessive thickening and stiffness of the pleura, **Schede's operation**, consisting in removal of the entire chest wall from the second to the ninth or tenth rib, including the intercostal muscles, is sometimes performed. After this operation only the parietal pleura, superficial mus-

cles, and skin remain to cover the lung. Its mortality is 15 to 20 per cent.

Delorme's or **Fowler's operation**, also termed **decortication of the lung**, is of value where the visceral (pulmonary) pleura has become so thickened as to bind down the lung and prevent its expansion. It is sometimes combined with Estländer's or Schede's operation, but may also be performed independently of these through a temporary osteoplastic flap in the chest wall, exposing the lung, from which the fibrous covering is then removed as completely as possible by stripping and the use of scissors. The thickened pleura is also removed from the thoracic parietes and the diaphragm. For details of the technique of these operations, see the article on the CHEST, SURGICAL DISEASES OF, Vol. III.

The employment of **Dakin's solution** is the method of choice in ordinary chronic empyema cavities of any size. A **pulmonary decortication** through a rib spreading exposure after preliminary irrigation is the most conservative treatment for cavities that are not obliterated by drainage or solution treatment alone. If the lung does not expand, or if a considerable cavity persists following it, a **plastic operation** is indicated. In the absence of bronchial fistulas and of bleeding, secondarily infected tuberculous empyema may be much benefited by the antiseptic solution. Adequate **drainage** is the first indication in cases of empyema cavities which are draining through large bronchial fistulas. Operative closure of bronchial fistulas that persist is necessary to complete healing. Hedblom (Annals of Surg., Sept., 1920).

In children, in whom pneumothorax causes greater difficulty of respiration than in adults, previous removal of a portion of the purulent exudate with a

sharp trocar is often advisable, in order to minimize the ill-effects of the succeeding operation to establish continuous drainage. **Rib resection** may be freely done, as regeneration of any removed portion will readily occur.

Where the needle reveals an encapsulated, circumscribed empyema, **incision** in that locality and **drainage** are indicated. The interlobar form of pleurisy, according to Segond and others, is best treated by **excision of the fifth and sixth ribs**. In bilateral empyema, the orthodox treatment is **aspiration** of one pleural cavity at a time, followed by **chest incision** on one side and the use of a **trocar** on the other, according to the relative degree of lung expansion on the two sides induced by the aspiration.

In empyema occurring in cases of pulmonary tuberculosis, repeated **aspiration** is generally preferred to free incision, in view of the serious dangers attending superadded mixed infection of the pleura. Bäumler recommends **thoracotomy with rib resection** where exploratory puncture shows pyogenic bacteria in the pus; otherwise, **aspiration**. The condition has been cured by **thoracocentesis** followed by injections of **mercury bichloride** and **boric acid** solution through the same needle.

Empyema following idiopathic pleurisy or of insidious onset is probably tuberculous, though tubercle bacilli may not be found for a long time. A sterile effusion, even if purulent, should not be drained openly, unless perforation of the chest wall is feared; repeated partial **aspiration** is indicated when there is dyspnea or cardiac embarrassment. If the lung is fixed in a collapsed condition or if the effusion repeatedly recurs, an **extrapleural plastic operation** is called for. A mixed infection in the closed cavity should be treated by **aspiration with irrigation** or

by **open drainage**. A large bronchial fistula should be treated by the open method. A plastic operation is usually required in closed empyema of long standing, and large, open, secondarily infected cavities. **Extrapleural rib resection** is indicated for the collapse of sterile closed cavities. Hedblom (Surg., Gyn. and Obst., Apr., 1922).

The creation of an **artificial pneumothorax** by the injection of **nitrogen**, **filtered air** or **oxygen** may be resorted to, and proves most useful in well marked or advanced strictly unilateral cases (Floyd).

In tuberculous exudates, the object is not to restore complete lung expansion; indeed, the lung condition may definitely require pulmonary collapse. Uninfected exudates need **puncture** only when they show no tendency to absorption or cause pressure symptoms. The quantity of fluid removed should not be too large. **Introduction of gas** will remove the risks of a too rapid lung expansion, which include aspiration of exudate and even miliary tuberculosis, but will not insure absence of adhesions. Again, the fluid should not be wholly replaced by gas; some serous fluid should be permitted to remain. Spengler (Beit. z. Klin. d. Tuberk., Mar. 15, 1922).

Where *actinomycosis* becomes complicated with empyema, the pleural infection is usually secondary to disease of the lung. Spontaneous evacuation through the chest wall not infrequently occurs. If not, measures to remove the pus should be taken. Massive doses of **potassium iodide** should also be administered.

CHRONIC DRY (PLASTIC) PLEURITIS.—This condition may either be preceded by pleural effusion or develop gradually as a dry pleurisy. In the first, or *secondary type*, after the absorption of the fluid there persists on the pleural surfaces a more or less marked deposit of

"lymph," some of which becomes organized into firm connective tissue. The respiratory movements are thus in some degree hindered, and dullness on percussion is noted, together with weakening and absence of the respiratory sounds and perhaps some retraction of the chest wall. The cicatricial tissue is most in evidence in the purulent cases, especially in those in which the discharge has persisted a long time. The lung is rendered airless and fleshy in these cases. In less-marked instances bronchiectasis may be produced.

In the second or *primary type* of dry pleurisy there is no history of a preceding pleural effusion. The resulting adhesions are usually limited to circumscribed areas of pleura, and are not infrequently met with at the autopsy table. Even though they be general, the respiratory functions may be unimpaired, and the exudate be so slight that upon examination no disturbance except Litten's diaphragm phenomenon is noted. Retraction of the intercostal spaces, together with loss of resonance on percussion and weakness or absence of the respiratory sounds, may be observed in the more serious cases, with pronounced pleural thickening. Fibrosis of the lung frequently coexists.

The form of chronic dry pleuritis known as pleurogenic pneumonia is associated with formation of a thick morbid-tissue deposit of tuberculous nature, which penetrates from the pleura in between the lobules of the lung-tissue, dividing it into distinct areas separated ultimately by connective tissue. Extreme thickening of the pleura itself may, moreover, occur in pulmonary tuberculosis.

Chronic adhesive pleuritis may also be part of a general chronic inflammation of serous membranes—multiple serositis or polyorrhomenitis—involving the peritoneum and pericardium as well as the pleura.

The symptoms of chronic dry pleuritis vary considerably. Among the most frequently met with are: dragging pain or aching in the side, becoming worse during inclement weather; dyspnea, particularly on exertion; impairment of the respiratory movements and sounds on the involved side; lessening of resonance and vocal fremitus; obscure friction sounds; and, in advanced cases, thoracic deformity and visceral displacements.

In addition, symptoms of coexisting chronic bronchitis or pulmonary tuberculosis may be present.

TREATMENT.—The treatment of chronic dry pleuritis should include the prescription of **pulmonary gymnastics** and regulated **outdoor exercise**, to favor expansion of the lung; **massage of the walls of the thorax**, and attention to the patient's general health. Such drugs as **iron, strychnine, quinine, nux vomica, hydrochloric acid, mercury, phosphorus, iodides**, and **codliver oil** should be administered when indications therefor are present. The **diet** should be **generous** and proper **hygienic** conditions provided for: Locally, **counterirritation** with **iodine** or appropriate ointments may be availed of to relieve pain.

PNEUMOTHORAX.

Under this term are grouped conditions in which air or other gas is present in the pleural cavity. Pure pneumothorax is exceedingly uncommon, fluid being nearly always

also present in the pleura, in which case the terms *hydropneumothorax*, *pyopneumothorax*, and *hemopneumothorax* are more strictly applicable.

SYMPTOMS.—In some instances the onset of pneumothorax is slow, and symptoms are slight or absent, the condition being ascertained only by accident or at autopsy. In other cases, however, the onset is rapid and severe, with sharp pain in the chest, pronounced dyspnea, cyanosis, and often symptoms of collapse, such as a rapid, feeble pulse and sweating. A sensation as of something giving way or of fluid trickling down within the thorax may be experienced. Death may follow rapidly if the affected lung has been playing the chief rôle in respiration in the individual case, if the escape of air into the pleura is rapid, or if the opening in the lung is of such a "valvular" type as will permit entrance of air into the pleura during inspiration—the suction effect of the chest assisting—but prevent its escape through the bronchus during expiration. On the other hand, the symptoms may be but slightly marked in advanced pulmonary tuberculosis, the respiratory needs being small and the pain, which is the most constant manifestation in such cases, being readily referable to a simple localized pleurisy, which is present very often in these patients. Careful investigation is thus desirable, to find out the cause of such attacks of pain in pulmonary tuberculosis. In neither advanced phthisis itself nor superadded pneumothorax is a persistently rapid respiration necessarily associated with dyspnea. As the air and liquid effusion increase in the pleural cavity the patient may breathe 50 or more times

to the minute without complaining of breathlessness.

PHYSICAL SIGNS.—In well-developed cases the physical signs are very characteristic. Upon raising the patient, who is apt to be found lying on the affected side to allow free play to the normal lung, to the sitting posture, the involved side is found enlarged and nearly motionless. The intercostal spaces are obliterated or bulging, and the cardiac impulse may be seen to be considerably displaced. The respiratory movements on the opposite side of the chest are exaggerated.

Palpation may reveal the heart displaced and the liver pushed downward, the latter especially in right-sided pneumothorax. Tactile fremitus over the affected lung is greatly diminished or absent, except perhaps over the site of adhesions of the lung to the chest wall. The degree of change in the percussion note depends upon the state of intrapleural tension, the tension of the intercostal muscles, and whether the pneumothorax is "open" or "closed." In the majority of cases, intrapleural tension not being augmented, it is clearly hyperresonant or tympanitic. This note frequently extends considerably beyond the usual limits of the affected lung, being transmitted across the sternum, because of displacement of the heart and mediastinum. Where there is increased intrapleural tension or contraction of the intercostal muscles, on the other hand, the note may be dull and the feeling of resistance on percussion increased. Frequently, moreover, there is dullness at the base of the chest, due to fluid accumulation in the lower portion of the pleural cavity:

this dullness shifts with the changes in the patient's posture. At times the tympany obscures the dullness of fluid actually present; or, the fluid may fail to yield dullness in the erect position because of having created for itself a concavity in the upper surface—normally convex—of the diaphragm, no fluid being thus in contact with the outer chest wall. A cracked-pot sound may at times be obtained.

Upon auscultation of a well-marked pneumothorax the breath sounds are usually found much reduced or absent, especially upon listening at the lower part of the thorax. What breath sounds exist may be metallic, bronchial, or amphoric in quality. The higher the intrapleural pressure the less distinct, as a rule, the breath sounds; if the pressure is low and the perforation open, loud amphoric breathing may be heard, due to transmission of bronchial sounds into the resounding pleural cavity. The vocal fremitus, as well as any râles present, also often possess a metallic quality. The phenomenon known as metallic tinkle, or falling-drop sound, can frequently be elicited upon deep breathing, coughing, speaking, swallowing, or movement of the body. The coin sign, elicited by the tapping of a coin placed flat on the front of the chest with another coin, while the observer listens on the back of the chest, is another characteristic sign of pneumothorax; when it is positive, a ringing, metallic sound is conveyed to the listener. Entrance or exit of air through the opening in the lung into the pleura sometimes gives rise to a peculiar whistling sound, which is especially characteristic when the opening is submerged in the intra-

pleural fluid. The Hippocratic succussion splash may be heard when both air and fluid are present in the pleura and is elicited by shaking the patient or requesting him to make sudden movements such as rapid sitting up or lying down; in some instances it is heard not only upon auscultation, but also at a distance. It may transmit a shock to a hand placed over the chest. The heart sounds in pneumothorax may be muffled or possess a metallic quality.

DIAGNOSIS.—Where the typical mode of onset, cause, and symptoms and signs of pneumothorax are present, even only in part, the diagnosis of the condition is readily made.

Pleural effusion has not infrequently been diagnosticated in cases with high intrapleural tension, the percussion not being relatively dull. Absence of the resistance to the percussing finger typical in pleural effusion and of the other signs of the latter condition should, however, avoid confusion in most instances.

Cavity of the lung in pulmonary tuberculosis, when extensive, may simulate pneumothorax in yielding tympany, amphoric breath sounds, metallic tinkling, and at times succussion splash. Absence of recession of the intercostal spaces and of the chest wall as a whole, as well as a negative coin test and a displacement of the heart, if anything, to the side of the lesion, are strong indications of cavity and of the absence of pneumothorax. Occasionally it is impossible to distinguish a small pneumothorax due to rupture of an emphysema into a bronchus or to the extension of a pulmonary cavity to the surface, from a cavity lying near the periphery of the lung.

Emphysema is bilateral, while pneumothorax is unilateral. In cases of fibrosis of one lung the compensatory emphysema of the opposite lung may simulate pneumothorax in physical signs, including displacement of the heart. Pneumothorax occurring where the opposite lung is so much crippled, however, would cause the direst distress,—a differential point.

Diaphragmatic hernia of the stomach and intestines from a crushing injury must also at times be considered in the differential diagnosis. In such a hernia the lung would be pushed upward rather than against the spine, and the breath sounds over it would be exaggerated and not amphoric or suppressed.

Subphrenic abscess due to ulceration of the stomach or bowel and containing gas may push the diaphragm high up in the chest and present the signs of pyopneumothorax. A history of abdominal trouble, harsh vesicular breathing in the lung above the abscess, great downward displacement of the liver, and but little displacement of the heart would, however, be of differential assistance.

The X-rays may be of much help in the diagnosis of pneumothorax. Characteristic in this picture are intense clearness over the pneumothorax and below this a dark shadow thrown by the exudate. The upper border of this shadow sinks and rises with respiration, and movement of this border can be obtained by breathing, change of position, and coughing.

ETIOLOGY.—Pneumothorax always results from perforation of the pleura and entrance of air through

the opening, except in rare instances in which the condition arises spontaneously, owing to infection of the pleura with *B. aerogenes capsulatus*, *B. coli*, or some other gas-producing organism. Pneumothorax is most frequent on the right side, in the male sex, and in adult life.

Pneumothorax from Disease of Thoracic or Abdominal Organs.—

The commonest cause of pneumothorax is perforation of the pleura by a tuberculous focus in the subjacent lung. About 90 per cent. of the cases are ascribed to this cause. Even in tuberculosis the condition is encountered only in a small proportion of cases. The perforation generally occurs while the patient is at rest, not rarely during sleep, and in the absence of cough or violent respiratory effort. These are the conditions in which hemoptysis also occurs.

Of the remaining 10 per cent. of cases of pneumothorax, the greater number are due to ulceration of an empyema into a bronchus. Other, less frequent, causes are rupture of a gangrenous focus or abscess of the lung, of an echinococcus cyst, an emphysematous bulla, a bronchiectatic cavity or a bronchopneumonic focus, puncture of the lung by a fractured rib, and possibly rupture of lung held down by adhesions during violent coughing or physical exertion.

Pneumothorax may also arise through rupture of a cancerous growth of the esophagus into the pleura, or through perforation of the diaphragm by an abscess resulting from ulcerative disease of the stomach or colon, provided communication with these organs is preserved.

Sometimes pneumothorax develops

in persons otherwise apparently healthy; many of these cases are probably tuberculous.

Pneumothorax from without may be due to traumatic injury, as in stab or other wounds of the chest, or to an abscess in the chest wall opening both externally and into the pleural cavity. Many cases of circumscribed pneumothorax follow thoracentesis, but symptoms only infrequently arise therefrom, the entrance of an amount of air not exceeding the volume of fluid evacuated exerting no harmful effect.

PATHOLOGY.—Pneumothorax may be of the open variety, in which air enters and leaves the pleural cavity during inspiration and expiration, respectively; of the closed variety, in which the point of original entrance of air into the pleural cavity has become closed; or, of the valvular variety, in which usually the entrance but not the exit of air from the pleura is permitted. In the last-named type, whenever expulsive expiratory efforts, such as coughing, straining, or blowing, are made, air is forced through the valvular opening into the pleural cavity, the pressure there becoming as great as during the most violent of these efforts. The side may thus become greatly enlarged, the diaphragm pushed down until possibly the entire liver is below the costal border, and the heart and mediastinum pushed to the opposite side. Distention with air can be easily demonstrated at autopsy by introducing a small cannula, when the air will escape with more or less force, as may be shown by its effect on a lighted match or candle.

The point of rupture of the lung

varies in size. Often small at first, it usually becomes larger if the patient survives. Generally, it can be found at autopsy, if not by direct inspection, then after forcing air through one of the bronchi. It is most often found on the external or posterior surface, between the third and sixth ribs. It is in the acute forms or phases of tuberculosis that perforation oftenest occurs, caseous foci near the surface of the lung breaking down and necrosis of the overlying pleura taking place before time for adhesion to the parietal pleura has been given.

Pneumothorax may be circumscribed or diffuse. In the latter variety, the air in the pleural cavity may amount to 2000 c.c. or even more. The air may or may not be offensive in odor. In closed cases, the oxygen is gradually absorbed and the carbon dioxide and nitrogen increased. In the fetid cases, hydrogen sulphide is also present.

The condition of the pleura in pneumothorax is variable. It may present the normal smooth and shining appearance, but in most instances lesions similar to those of purulent pleuritis are found. The membrane may then be much thickened and covered with a thick layer of lymph, and the lung is apt to be adherent to the parietes in various places. While in rupture of a healthy or an emphysematous lung no exudation of fluid into the pleural cavity may occur, the frequency of pleuritis in cases of perforation due to ulcerative processes naturally involves the presence of fluid—sero-purulent or, more often, purulent—in addition to the air in the pleura. This may be present in such amount

as to exert a distinct effect in compressing and displacing thoracic or upper abdominal viscera. In traumatic as well as ulcerative cases, blood may also be found in the pleural cavity. In rare instances pneumothorax is bilateral.

PROGNOSIS.—This depends on the cause of the pneumothorax and the condition of the patient at the time. Recovery occurs oftenest in previously healthy subjects. In most other instances, however, including tuberculous cases, the prognosis is grave. West, collecting 160 cases of pneumothorax, found the mortality to have been 62½ per cent. Much depends upon the condition of the opposite lung. If it is only slightly diseased, and the general condition is good, recovery may occur. On the other hand, where there is extensive tuberculous disease of both lungs, prompt death is the rule. In a few cases death occurs in some hours or days; in most instances—the rule in tuberculous cases—it takes place within a few weeks. In 39 cases Powell found the average duration of life to be twenty-seven days.

Among the factors upon which the prognosis depends are: the urgency of the symptoms, *i.e.*, the amount of dyspnea and cyanosis; the ability of the right heart to overcome the increased resistance in the pulmonary circulation, any sign of dilatation being unfavorable; the general strength of the patient—in particular the development of the respiratory muscles. The appearance of râles is a very bad omen (West).

Death may occur either from rapid suffocation or shock, as a result of effusion, or as a result of the

original disease process, *e.g.*, tuberculosis. The proportion of deaths is much greater during the first week than at any subsequent time.

In some cases of tuberculous pneumothorax the condition becomes chronic and does not terminate for months or years. In occasional cases a tuberculous condition in the lung is arrested by pneumothorax, as in cases of intentional artificial pneumothorax.

In traumatic pneumothorax the prognosis depends largely upon the nature of the injury.

In spontaneous pneumothorax in children, the prognosis is favorable. Only a valve pneumothorax causes grave symptoms. Puncture will generally relieve these cases. K. Benjamin (Arch. f. Kind., Mar. 20, 1926)

TREATMENT.—In cases where the onset is sudden, with severe symptoms, **morphine** should be given subcutaneously for the relief of the pain and dyspnea, as well as to allay mental distress. Stimulants, such as **caffeine** and **camphor** are usually required to combat the tendency to circulatory failure. Where cyanosis and dyspnea are great, **dry cupping** may give some relief. **Bromides** may be used if indicated. A generous nutritious **diet** should be given. The patient should be kept **quiet** and carefully watched. If no marked disturbances follow, no attempt should be made to evacuate the pneumothorax, as in a certain proportion of tuberculous, traumatic, or other cases, spontaneous absorption of the air in the pleural cavity takes place.

In the very acute "suffocative" cases, however, due to a valvular opening into the pleura, **thoracentesis** should be performed under strict

surgical precautions as soon as the diagnosis of pneumothorax has been made. The air should be allowed to escape through a cannula, without the use of suction, which tends to reopen the lung perforation where it has become closed. The paracentesis should be repeated, if necessary; or, **continuous drainage** may be practised, preferably by connecting with the cannula a rubber tube twenty inches long, with its distal extremity dipping into water in a test-tube, to prevent the drawing in of air into the pleural cavity, and to favor healing of the opening in the lung. Where simple paracentesis is practised, subcutaneous emphysema may follow removal of the cannula; this may be obviated by making pressure on the puncture for a short time.

For the pain caused by the pleurisy that usually follows the onset of pneumothorax, **cupping** may be resorted to, followed by **hot fomentations**, after which the **chest** may be **strapped**.

In tuberculous cases with a purulent pleural exudate the course may be chronic, without marked disturbance. Moreover, the compression of the lung by the pneumothorax may prove useful, leading to arrest of the tuberculous process. Thoracentesis or even free incision are likely to give but temporary relief, and the latter may lead to further infection and sepsis. Greater activity of the tuberculous process is also often excited. These cases are therefore best left alone,—unless serious dyspnea and cyanosis appear, or the seropurulent exudate present becomes excessive in quantity. Under the latter circumstances, **thoracentesis** should be performed, and later repeated if

necessary. **Siphonage** is generally considered preferable to aspiration, in that the danger of reopening the point of rupture in the lung and converting the closed pneumothorax into an open one is less. Where a true pyopneumothorax exists, with presence of a considerable quantity of pus, the treatment required is, as a rule, that of purulent pleuritis in general, viz., **incision** and **drainage** (see section on SUPPURATIVE PLEURITIS, in this article). The condition of the patient and, in particular, of his other lung, together with the chances of reopening the perforation in the lung and of lighting up a quiescent tuberculous process must, of course, be given due consideration in deciding whether to intervene. In operating, the sound side should always be turned upward, death from a flow of pus into the bronchi of the sound side having occurred in 2 cases in which the affected side was turned up to facilitate operation (Bowles). As in empyema, **rib resection** may be necessary, and subsequently **pulmonary gymnastics** should be systematically carried out to secure re-expansion of the lung.

In pneumothorax due to perforation of a bronchial tube by an empyema prompt **drainage** is urgently required. Where the fluid is putrefactive in character and fetid, the danger attending non-intervention is even greater, free drainage affording the best, if not the only, hope of relief.

In traumatic pneumothorax the chief danger is infection of the pleura. Where the pleura is manifestly infected, **drainage** should be provided for. If, on the other hand, the wound is apparently clean, the

opening in the chest wall, after disinfection of the wound, should be sealed, the pneumothorax being thus rendered a "closed" one.

In pneumothorax occurring accidentally during thoracentesis, due to forcing of air into the pleural cavity through the making of a wrong connection with the instrument, the air should immediately be allowed to flow out again by disconnecting the cannula and tube or by actual aspiration.

HYDROTHORAX.

This signifies a serous transudation into the pleural cavity, occurring independently of inflammation. It is also termed pleural dropsy or pleural edema.

SYMPTOMS.—The symptoms are such as result from interference with respiration and pressure on intrathoracic organs, viz., dyspnea, cyanosis, cough (sometimes paroxysmal), and circulatory insufficiency. These symptoms are likely to be referred to the primary disease, and the hydrothorax overlooked. Wherever such symptoms are met with in increasing intensity, pleural dropsy should be thought of and removal of the fluid effected if necessary.

The *physical signs* are those of sero-fibrinous pleuritis. Vocal fremitus is absent. The breathing may be bronchial on account of collapse of the air-vesicles; it is usually faint. On light percussion a dull note is obtained. There is no friction rub. Sometimes there is a crepitant râle over the upper part of the effusion and above it. The transudate, being more limpid and not held by adhesions, shifts more easily upon change of posture than that of pleuritis.

DIAGNOSIS.—In failing cardiac compensation especial subjective distress should suggest the thought of a right-sided hydrothorax. Confirmation of this suspicion is afforded by the physical signs of fluid in the pleural cavity and by examination of a removed specimen of the fluid.

ETIOLOGY.—Most cases of hydrothorax occur as a part of general dropsy, especially in cardiac failure, renal disease, and pulmonary emphysema with secondary heart-failure. In heart disease the condition is often limited to one pleural cavity, whereas in renal disease both are usually affected. An intrathoracic tumor may cause dropsy on one or both sides, from pressure on the azygos veins. Other conditions that may give rise to hydrothorax are: pernicious anemia, leukemia, scurvy, cachectic states such as attend carcinoma or sarcoma, any condition causing hydremia, and possibly also disease of the capillaries or toxemia.

PATHOLOGY.—The effusion consists of a clear, straw, or pale, amber-colored fluid, rich in albumin usually (1 to 3 per cent.)—richer than the dropsical fluids of the pericardium, peritoneum, or subcutaneous tissues. Microscopically, the fluid contains leucocytes, red cells, and an occasional endothelial cell.

In recent cases the pleura is normal in appearance, but after a time it loses its glistening appearance on account of a slow, low-grade inflammation. The pleural lymphatics may, by their dilatation, form a distinctly visible network. More or less pronounced collapse of the lung also occurs.

TREATMENT.—The treatment must be directed mainly to the cause.

In the cases of cardiac origin, any **improvement** procured in the **circulation** will usually cause disappearance of the pleural edema. If such improvement is not speedily secured, however, the fluid should be removed by **aspiration**, such removal in itself being sufficient to lead to a recovery of compensation, especially if the right ventricle be simultaneously relieved by **venesection**. **Digitalis** and similar drugs, if previously given without benefit, are then likely to become effective.

HEMOTHORAX.

This is the condition arising as a result of hemorrhage into the pleural sac.

SYMPTOMS.—The general symptoms of hemorrhage are present, and if the escape is rapid and large there is dyspnea in proportion to the pressure on the lung. Symptoms of pleuritis without fever or friction are present. The percussion note is absolutely flat when coagulation takes place, even if only in a thin layer.

Combination of the signs of loss of blood with those of a rapid accumulation of fluid in the pleural cavity are the chief diagnostic features of hemothorax.

ETIOLOGY.—Hemothorax may arise from traumatism or from rupture or erosion into the pleural cavity as a result of disease processes in neighboring tissues. In traumatic cases there may be rupture of an intercostal or mammary artery, or laceration of the lung, at times accidentally during aspiration. Rupture of an aneurism of the aorta into the pleural cavity, not infrequently occurs. Occasionally rupture of an aneurism of the internal mammary

takes place, and in rare cases there is rupture of a vein into the pleural cavity. Rarely bleeding occurs from rupture of a pulmonary infarct or of a tuberculous cavity. Hemorrhage into the pleura may also take place in scurvy and in purpura.

PROGNOSIS.—This varies with the origin of the bleeding, its amount, and the possibility of reaching the bleeding point by surgical means. In traumatic cases early coagulation takes place and the serum is rapidly absorbed; the clot is long, however, in disappearing. If infection occurs, suppurative pleuritis follows. Where the largest vessels are involved the prognosis is wholly unfavorable.

TREATMENT.—The treatment is generally expectant unless the bleeding point can be readily located and secured. Bleeding from the chest wall can be stopped by the application of a **ligature**, while in hemorrhage from traumatized lung-tissue recovery may occur if the patient be kept absolutely **quiet** and an **opiate** given. If, however, there is urgent dyspnea some of the blood should be removed by **aspiration**, or, if the necessary experience in and facilities for intrathoracic surgery are available, the **chest** may be **opened** under **differential pressure**, the source of the bleeding determined, and the maneuvers required to arrest it carried out.

CHYLOTHORAX.

This condition occurs in two forms: (1) true chylothorax, in which true chyle from the thoracic duct is present in the pleural cavity; (2) false chylothorax, in which the fluid present is not chyle, but an exudate rendered chyle-like by the large number of contained fat globules, derived

from diseased pleural epithelium and pus-cells.

SYMPTOMS.—The symptoms are those of a non-inflammatory effusion or a pleural tumor. Pain may result from distention of the pleural cavity. Aspiration will determine the diagnosis, which is usually not made until this procedure is carried out; but there may be difficulty in withdrawing the fluid.

ETIOLOGY.—It is usually caused by obstruction of the thoracic duct or the receptaculum chyli, but may be due to rupture of either of them. In many cases the seat of lesion cannot be found at the autopsy. The obstruction may be caused by a cancerous growth or a tuberculous deposit. True chylothorax, which is a rare condition, is usually due to traumatic rupture of the thoracic duct or to obstruction of it or of the receptaculum chyli through pressure of external tumors or of tumors in these structures themselves. It may also be due to thrombosis of the left subclavian and internal jugular veins or to blockage by parasites. False chylothorax is an infrequent complication of carcinoma of the pleura and of tuberculous pleuritis.

PATHOLOGY.—Chyle differs from chyliform fluid in containing but 1 per cent. or less of fat, while chyliform fluid may contain 5 or 6 per cent. Its fat and protein granules are also likely to be coarser than those of chyle, while the latter is more likely to contain sugar. In either form of chylothorax, fluid of a similar nature may be present in the peritoneal cavity.

PROGNOSIS.—This is, on the whole, unfavorable, death generally occurring in six to ten months.

Spontaneous repair sometimes takes place in the traumatic cases. Attempts at surgical correction of the condition are not often attended with success.

TREATMENT.—This depends upon the cause of the condition and the symptoms produced. Where the accumulation of fluid induces pain, **thoracentesis** should be performed, repeatedly if required. In the tuberculous cases this yields some hope of recovery. **Strapping of the affected side** and **thoracotomy with rib resection** are measures of possible utility.

NEW GROWTHS OF THE PLEURA.

These may be primary, but the majority are secondary to neoplasms situated elsewhere. Most of the latter variety arise by direct invasion from a primary lesion in the lung; the remainder are secondary to new growths of the mammary gland, the liver, the kidneys (hypernephroma), and the lymphatics of the mediastinum.

Of the primary growths, endothelioma or endothelial carcinoma is the most common. Round or spindle-celled sarcoma may also occur.

Of benign tumors, lipoma, fibroma, and chondroma are sometimes met with.

SYMPTOMS.—These are decidedly variable, but in general resemble those of chronic pleuritis, with the addition, frequently, of more or less local pain or discomfort, with progressive loss of weight and strength, and anemia. Cough and dyspnea are generally present. Where a primary cancer of the lung has been followed by diffuse involvement of the pleura, the pleural manifestations may pre-

dominate and obscure the pulmonary disease.

The physical signs usually point to a pleural effusion of considerable extent, frequently with cardiac displacement. On inspection, the thorax may be found distended, markedly retracted, or irregularly distended and retracted. On inspection, dullness is to be expected, but it is likely to vary in intensity in different places and to be irregular in outline. Fremitus is diminished and the respiratory sounds weakened.

DIAGNOSIS.—Clinical distinction between pleural neoplasm and *chronic tuberculous pleuritis* is difficult until the condition is well advanced. The diagnosis is best reached by exploratory puncture, which, in the case of neoplasm, will yield a fluid typically blood-stained and containing tumor-cells, *e.g.*, sarcoma spindle-cells, or small bits of the growth, visible microscopically.

PATHOLOGY.—Pleural growths are usually soft and flattish, though causing a more or less pronounced thickening of the normally tenuous membrane. In most instances of endothelioma there is much thickening, due mainly, however, to inflammatory reaction rather than to the growth itself.

Metastasis to the lungs and to other structures may occur, and the growth may appear under the ribs and infiltrate the skin.

PROGNOSIS.—The prognosis of pleural neoplasm is unfavorable, death usually ensuing in a few months.

TREATMENT.—This is purely symptomatic, the condition not being amenable to curative treatment. Pain or discomfort should be relieved

with **opium** or **morphine**, and **thoracentesis** practised when fluid accumulation causes dyspnea; repeatedly if necessary.

ECHINOCOCCUS INFECTION OF THE PLEURA.

This condition is very rare, being met with primarily in the pleura in probably less than 1 per cent. of all cases; as a secondary infection, especially from the liver and lung, it is somewhat more frequent.

SYMPTOMS.—As in hydatid cysts of the liver the health may continue good. Pain, however, may be an early and persistent symptom. Pressure symptoms are added as the cyst enlarges, and the lung becomes compressed and the heart displaced. The temperature is normal unless inflammation develops. Anemia and loss of flesh may become marked. Occasionally there is hemorrhage into the pleural cavity.

DIAGNOSIS.—This is usually difficult. The evidence of a growing cyst without fever is suggestive. Pain and loss of flesh may be present. Tactile fremitus is absent. *Circumscribed pleuritis* and *new growth* may be differentiated by puncture and examination of the fluid for hooklets, but such puncture is hardly justifiable unless it can be immediately followed by radical operation. The complement-fixation test may be availed of.

PATHOLOGY.—The cyst is usually single, growing inward from any part of the pleura. It compresses the lung and gives rise to the signs of a circumscribed pleural effusion, of which the outline may be irregular. In a few cases it grows outward and causes bulging of the chest wall and may perforate it, causing a chronic

fistulous opening. The cyst-wall is formed externally of the much thickened and dense pleura, and internally by the laminated membrana propria of hydatid cysts. The fluid contents are clear, or rarely purulent from secondary infection (McPhedran).

TREATMENT.—The condition usually terminating in death if allowed to run its course, energetic treatment is indicated. Simple aspiration is rarely sufficient and, though direct drainage of the cyst with the trocar has been successfully procured, the mortality from this procedure has been too high to permit of its general employment. To secure the best results the cyst must be removed unruptured; this is best accomplished by free incision with resection of ribs. Cases promptly treated in this manner nearly always recover completely.

C. E. DE M. SAJOUS

AND

L. T. DE M. SAJOUS,
Philadelphia.

PNEUMONIA, LOBAR.—Lobar pneumonia (croupous pneumonia; fibrinous pneumonia; pneumococcic lung infection; pneumonitis; lung fever) is an acute infectious disease due to the *Diplococcus pneumoniae* and characterized by pneumococcic bacteremia and a special inflammation of portions of one or both lungs, proceeding to solidification.

SYMPTOMS.—The duration of the incubation period is believed to vary from some hours to several days. The prodromes are indefinite and, in fact, usually absent, the onset being generally sudden with a chill, often severe and lasting from one-half to several hours. In adults it is only occasionally preceded by one to several

days of ill health, featured by such manifestations as laryngitis, bronchitis or coryza, anorexia, headache, dull pains in the extremities or abdomen, and malaise. Sudden, pronounced thoracic oppression is the initial complaint in some instances.

In children, convulsions, vomiting, or delirium may replace the chill as the initial symptoms.

In some instances a gradual onset is noted, with indefinite, non-characteristic prodromal symptoms persisting for a few days to a week. Where bronchitis precedes the pneumonia, the onset of the latter may likewise be either gradual and insensible, or sudden and attended with a chill or some marked chest symptom. Such symptoms as cough, slight dyspnea, and pain in the thorax may be manifestations either of pre-existing bronchitis or of the incipient pneumonia itself.

While lobar pneumonia is typically initiated by a chill, in 40 per cent. of the cases studied it was lacking. Among the prodromal symptoms were coryza, bronchitis, sore throat and muscle pains. Pain in the chest occurred in 90 per cent. of the sthenic type, often preceding chill and fever, and often referred to the abdomen, neck and arms. Sudden disappearance of pain may mean pleural effusion. C. L. Greene (Minn. Med., Sept., 1923).

After the chill, the temperature rises quickly, often attaining 104° F. (40° C.) in a few hours. The face becomes flushed, and a circumscribed, deep-red spot often appears on the side of the affected lung. Subjective complaints begin early on the first day, promptly after the termination of the chill. Pain on the affected side, especially during inspiration, is often a prominent symptom. A dry cough, half suppressed because

of the pain it occasions, soon sets in, greatly augmenting the patient's suffering. Headache and muscular pains are also likely to be complained of. Complete anorexia is usually noted, and often there is vomiting. Marked thirst appears, the skin is dry, the pulse rapid, the urine scanty, and the bowels generally inactive, though occasionally diarrhea occurs. Usually the patient lies on the affected side until the pain has largely disappeared.

On the second day the cough generally becomes more productive, a characteristically viscid, airless, tenacious, and rusty or blood-stained sputum being expectorated. At the same time the physical signs of lung consolidation usually appear, though in some instances—in central pneumonia especially—they may be delayed until the third day. The effects of general toxemia are also manifest in sleeplessness and delirium. On the second or third day, an eruption of herpetic vesicles about the lips and *alæ nasi* develops. The respiration becomes rapid and shallow owing to reduction of functioning lung-tissue by the pathological process. The resulting dyspnea may even be accompanied by cyanosis and suffusion of the conjunctivæ.

In from five to nine or ten days the febrile movement generally terminates by crisis,—sometimes accompanied by abundant sweating or diarrhea,—after which convalescence, as a rule, becomes rapidly established.

Symptoms in Detail.—*The Fever.*—In typical cases the temperature, after quickly rising to 104° F. (40° C.) or over, remains high until the crisis. For two or three days it may not vary more than 1° F. during the twenty-four hours. Slightly larger

remissions during the night are then likely to occur. Often, preceding the crisis by a day or two, and occasionally even earlier in the course of the disease, there is noted a fall in temperature to between 99° and 101.5° F. (37.2° and 38.5° C.),—a pseudocrisis,—followed by a return to the previous level. In some cases the temperature rises just before the crisis even above its previous level—the precritical rise. Such a rise may, on the other hand, be the forerunner of death; though in the majority of instances death is preceded by a fall in temperature. The crisis may take place anywhere between the third and the fourteenth day; typically, it occurs on the seventh or the ninth day. It consists in a drop of temperature to normal, or more frequently below normal, taking place usually at night, accompanied by sweating, occupying two to twelve hours, and followed by symptomatic relief and usually a prolonged, refreshing sleep.

Elsner found the initial chill absent in 14 per cent. of 150 cases of croupous pneumonia occurring in adults. In debilitated or old persons, as well as in drunkards, the temperature is not likely to rise so high as in previously robust and normal persons, averaging 102° or 102.5° F. (38.8° or 39.1° C.). In some instances—afebrile pneumonia—there is no rise in temperature. On the other hand, in some cases the temperature may be unusually high—106° or 107° F. (41.2° or 41.8° C.)—throughout the disease. The critical period may be unduly prolonged, lasting twenty-four hours or more; or, not infrequently owing to some complication, or where the disease persists after

the tenth day, the temperature decline may be by lysis. A slight post-critical rise in temperature may be noted.

Respiratory System.—The rate of respiration typically rises to 30 or more per minute on the first day, and may later attain 40 to 60 in adults and 60 to 100 in children. At first superficial and repressed owing to pain, it may later become panting, especially in old patients. Accompanying expiration is an audible "grunt," considered almost pathognomonic of the disease. Actual dyspnea with air hunger is frequently present, owing to reduction in functioning pulmonary surface through solidification of portions of the lung, but at times no lack of oxygen exists and the increased respiratory rate may be due to the action of toxic bodies in the blood on the respiratory centers, subsiding promptly at the crisis in spite of persisting impairment of pulmonary functioning. Other possible causes of rapid breathing are associated general bronchitis, heart-failure, pericarditis, and pleural effusion. Commonly the pulse respiration ratio becomes 2 to 1 instead of the normal 4 to 1.

Stab-like pain in the affected side is a constant symptom where the pulmonary lesion extends to the periphery of the lung, and is usually ascribable to inflammation of the pleura. It is usually referred to the region of the nipple or to the axilla or lower ribs of the involved side; less frequently to the abdomen, to a point below the scapula, or to the opposite side. Occasionally, the reference of pain to the abdomen is so marked that a wrong diagnosis or even an operation for appendicitis is

determined on. The pain is greatly intensified by coughing or deep breathing, but gradually disappears after being present for two or three days. In aged and markedly toxemic cases it may be absent.

Cough is another very constant symptom, though occasionally absent in drunkard, adynamic, or aged cases. At first short and unproductive, and probably arising through the bronchitis associated with the pulmonary lesion, it soon becomes less harsh, owing to the elimination of sputum, at first mucoid and frothy. In a few hours, the sputum becomes reddish or yellowish red and characteristically viscid, adhering to the receptacle even when it is inverted. In aged and alcoholic cases the sputum may be of the "prune-juice" variety, *i.e.*, thinner and darker in color, owing to greater admixture of blood. It may even be frankly hemorrhagic in severe cases, and in a few instances exhibits a greenish color. About the time of the crisis the sputum generally becomes more or less purulent in appearance, less viscid, and hence more easily expelled. In adynamic cases and in the very young and very old, the sputum may be scanty or absent throughout the disease.

Microscopic examination of pneumonic sputum reveals the *Diplococcus pneumoniae*, frequently in association with other micro-organisms, numerous more or less degenerated erythrocytes, epithelium from the pulmonary alveoli, pus-cells, mucus, and sometimes small fibrinous plugs and casts from the air-cells and bronchi. At times the reddish coloration of the sputum is due solely to dissolved blood-coloring matter,

the erythrocytes themselves having broken up.

Circulatory System.—In the average case of lobar pneumonia in the adult the pulse rate is 100 to 110 or 120. The rate usually corresponds to the intensity of the disease, and where a rise above 120 takes place cause for apprehension exists. At first the pulse is full and bounding, but later, when consolidation is extensive and especially where the disease is severe, it becomes small, feeble, more rapid, frequently irregular, and occasionally dicrotic.

The blood-pressure, at first normal, begins to descend in three or four days. There are often considerable variations in it from day to day, however, by reason of such factors as dyspnea, restlessness, amount of lung tissue involved, and reaction to toxemia. Some stress is laid on Gibson's rule to the effect that when the pulse beats per minute are higher than the systolic blood-pressure in millimeters of mercury circulatory equilibrium is seriously disturbed and the prognosis less favorable. Arrhythmia before the crisis was regarded by Mackenzie as an ominous sign.

Among 78 cases of lobar pneumonia and bronchopneumonia studied, there were 31 in which the systolic pressure was definitely less than the pulse rate; over one-half of these patients died and of those that lived there were only 6 in which a diagnosis of myocarditis was not made. The mortality of the entire series was 41 per cent. Arrhythmia occurred in 6 cases (premature beats in all but 1 instance), of which 2 died. Myocarditis was diagnosed in 29 cases, of which 16 died. F. T. Billings (Amer. Jour. Med. Sci., June, 1926).

The heart sounds in pneumonia are typically definite and clear. The pulmonary second sound is accentu-

ated owing to increased blood-pressure in the pulmonary system, due, in turn, to the consolidation of lung-tissue. Low-pitched, functional murmurs at the mitral and tricuspid valves are common at the height of the disease, the myocardium being weakened through toxemia and the pressure in the pulmonary circulation excessive. Where serious impairment of cardiac power occurs, especially in the overtaxed right ventricle, the intensity of the first sound promptly diminishes and the previously accentuated pulmonary second sound becomes indistinct; later, there may be extension of heart dullness to the right, embryocardia, epigastric pulsation, and cyanosis. Excessive toxic action on the vasomotor center also not infrequently results in sudden circulatory insufficiency. Collapse from heart-failure is especially to be apprehended at the critical period.

Blood.—Leucocytosis, beginning with the onset of the disease and persisting until after the crisis, is a feature of most cases of pneumonia. The usual number of leucocytes is 15,000 to 45,000. A slight leucocytosis, though at times occurring in mild cases, is usually an unfavorable prognostic sign, and is met with chiefly in cases with marked toxemia and asthenia. Other blood-changes include: An increase of the polymorphonuclears, often up to 80 per cent.; reduction or absence of eosinophiles during the height of the disease, with reappearance at or after the crisis; a decrease in the red cells and hemoglobin after the crisis; a decrease in the blood-plates up to the crisis, after which they rise above normal; a marked lengthening of the coagula-

tion time during the acute stage, and, under certain circumstances, the presence of the pneumococcus. In cases terminating by lysis, the decline from the characteristic leucocytosis is gradual instead of sudden. A leucopenia may be met with in malignant cases of pneumonia.

Nervous System.—Headache may be a persistent symptom in pneumonia. In mild cases mental dullness or slight mental wandering, together with prostration, complete the nervous effects of the disease. In more severe cases there is often a constant delirium, generally of the low, muttering variety, but occasionally maniacal. Meningeal inflammation is at times found *post mortem* to account for the severe mental disturbance in these cases. Delirium seems to be more common when the apices are involved. In drunkards true delirium tremens is apt to develop, sometimes as the initial manifestation of the disease. In children, convulsions at the onset are frequently encountered, and the disease may even run its course as a meningitis. In some instances mental symptoms begin about the time of the crisis, and persist for some days thereafter; this occurs mainly where there is cardiac or vasomotor weakness.

Alimentary Tract.—Vomiting is a frequent symptom at the outset, especially in children. Anorexia exists and the thirst is pronounced. The tongue presents a yellowish-white coating; it may later become brown, dry, and possibly fissured. Constipation is the rule, though diarrhea is at times met with. Tympanites may develop, owing either to toxic intestinal paresis or to a pneumococcic enteritis or colitis. The spleen is

generally palpable and the liver may be displaced downward, especially in right-sided pneumonia.

Skin.—Herpes is an important symptom, occurring in approximately one-third of the cases on the lips and *alæ nasi*, and generally appearing on the second to the fourth day. Sometimes the herpes appears in successive crops. Occasionally it is encountered on the cheek, ear, tongue, forearm, genitals, anus, or legs. A dusky flush may be noticed on one or both cheeks. Sweating is most common at or after the crisis, but may be observed at any time.

Kidneys.—The urine is diminished in amount, of high specific gravity, highly colored, and contains a marked excess of urates and uric acid and an increase of urobilin. Albuminuria is frequent, and occasionally acute nephritis occurs. In most but not all instances, the chlorides in the urine are greatly reduced in amount or absent; this is presumably due in part to a diminished intake of salt, the result of anorexia, and in part to accumulation of chlorides in the lung-exudate. Acetone appears in the urine. The freezing point of the urine is considerably lowered.

In 50 cases, the non-protein nitrogen was found increased from 34 to 156 mgm. per 100 c.c. of blood. The uric acid then rose from 3.8 to 11 mgm., and the urea nitrogen later to 20 mgm. or more. The creatinin then increased, at times exceeding 5 mgm., pointing to renal impairment. The blood chlorides showed a distinct decrease before the crisis. No definite relation of chlorides to clinical manifestations could be established. At the crisis, the chlorides quickly rose to above 0.50 per cent., then declined to normal limits. J. A. Killian (Proc. N. Y. Path. Soc., Jan.-May, 1922).

Physical Signs.—Stage of Congestion.—*Inspection.*—Expansion is often much diminished on the affected side, especially in case of basal involvement, though no change in the contour of the thorax can be perceived. This limitation of respiratory movement is ascribed to involuntary fixation of the chest wall because of the severe pleuritic pain. For the same reason the patient often lies on the affected side, to minimize rubbing together of the visceral and parietal pleura. The rate of respiration is increased. In bilateral pneumonia, costal breathing, with pronounced movements of the abdominal muscles, is noted.

Palpation.—Tactile fremitus over the congested pulmonary segment is slightly increased.

Percussion.—The percussion note, as the lung becomes engorged, is usually higher pitched than normal and may actually possess a tympanitic quality (Skodaic resonance). At times the percussion note is normal.

Auscultation.—Respiratory sounds are feeble or bronchovesicular,—the latter upon deep inspiration. Over the uninvolved lung-tissue exaggeration of the breath sounds is likely to be noted. Shortly after the onset—usually at the close of the stage of congestion, which lasts about twenty-four hours,—the characteristic crepitant râle may be detected, especially at the end of a full inspiration. According to Kidd, however, localized deficiency of breath sounds is a commoner and more valuable sign of commencing pneumonia than the crepitant râle. Various other râles, coarse or fine and moist or dry, may be heard over both lungs, where, as is frequently the case, acute bronchial catarrh co-exists.

At the termination of the congestive stage a friction rub, due to deposition of a layer of fibrin on the pleura, may be heard.

As an early evidence of pneumonia in infants the writer lays stress on the hearing of fine crepitant râles when the ear of the observer is held close to the infant's mouth. The fine crepitant râles may sometimes be thus heard before any other signs of the disease exist. Burghard (*Arch. f. Kinderh.*, Mar. 20, 1926).

Stage of Consolidation.—*Inspection.*—Expansion over the affected area is greatly reduced or quite absent, owing to solidification of the lung; on the uninvolved side it is augmented. Mensuration may show enlargement of the affected side to the extent of 1 or 1½ cm., but the natural depressions between the ribs persist.

A pronounced limitation of functioning lung-surface by the disease process may become manifest in dyspnea, activity of the auxiliary muscles of respiration, dilatation of the nostrils, and cyanosis, most marked in the cheeks (sometimes unilateral cyanosis on the involved side) and lips.

Palpation.—Tactile fremitus is much increased in lobar pneumonia, unless pleuritis with effusion coexists or the bronchi are closed by mucus or fibrinous exudate.

Percussion.—Dullness varies from a slight grade in the first stage to marked dullness when complete consolidation has occurred. The dullness is most pronounced posteriorly and is unchanged by full inspiration. There is increased resistance to the percussing finger, but this is not as marked as in pleural effusion. Anteriorly the note may be somewhat

tympanitic, owing to the proximity of the larger bronchi. Flatness may be noted in massive pneumonia (with the large bronchi plugged by exudate) or if pleuritis sufficient to cause effusion exists. Dullness is less marked in the very young and in the aged. The portion of lung just above the consolidated segment is apt to yield a note with a tympanitic quality (Skodaic resonance).

Auscultation.—Over the consolidated lung-tissue bronchial breathing is heard, unless the large bronchi are plugged with exudate, when it is absent. The voice sounds assume the qualities peculiar to bronchophony, or may even possess the bleating and nasal characteristics of egophony. The crepitant râle typical in beginning consolidation soon disappears, but subcrepitant râles, both dry and moist, due to coexisting bronchitis, can often be very distinctly heard because of the consolidation. Unaffected lung-tissue manifests exaggerated vesicular breathing through compensatory functioning.

Stage of Resolution.—*Inspection.*—Expansion on the affected side gradually returns, air re-entering the alveoli.

Palpation.—Tactile fremitus becomes progressively less.

Percussion.—Dullness gradually lessens, the note becoming more tympanitic and eventually resonant, though the impairment of resonance at times persists for a long period after seeming recovery.

Auscultation.—The breath sounds gradually become bronchovesicular and eventually vesicular. As the exudate liquefies, loud, moist râles, fine as well as coarse, make their appearance, and the crepitant râle, pre-

viously lost, may return (crepitus redux).

In some cases of pneumonia the appearance of the physical signs is greatly delayed, occasionally until nearly the time of the crisis. In some instances even they never appear, though the symptoms point to lobar pneumonia as the condition present.

CLINICAL VARIETIES OF LOBAR PNEUMONIA.—**Central Pneumonia.**—In this variety, the pneumonic process beginning in the center of a pulmonary lobe and gradually extending to its periphery, the physical signs are at first indefinite. Either the diagnosis is made mainly on the symptoms—pain, however, being usually absent owing to lack of pleural involvement—or the disease runs its course wholly, or at least for a certain period, unsuspected (latent pneumonia).

Apical Pneumonia.—This is common in children, is often very grave, and is more likely than ordinary basal pneumonia to be attended with marked nervous phenomena, especially delirium. By reason of the slight cough and expectoration this variety of pneumonia often remains undetected.

Massive Pneumonia.—In this form there is involvement of the whole or nearly the whole of a lung, with extension of the fibrinous exudate from the alveoli into the bronchi. The physical signs simulate pleural effusion, tactile fremitus and breath sounds being absent and the percussion note flat. Coughing is sometimes followed by expectoration of the exudate in the bronchi, the typical, pneumonic, physical signs thereupon suddenly appearing and the diagnosis being cleared up.

Migratory Pneumonia.—In this form, also termed wandering or creeping pneumonia, different segments of one or both lungs are successively involved. The onset of the condition may have been gradual, exacerbation of the symptoms occurs at the time of migration, and lysis generally replaces crisis.

Double Pneumonia.—One or more lobes of both lungs are involved, without any special modification of the symptoms. In "crossed" pneumonia, the lower lobe of one lung and the upper lobe of the other are involved.

Abortive Pneumonia.—In abortive, or larval, pneumonia the typical chill, fever, and cough are followed by crisis and recovery in one to a few days. Râles and signs of pleural involvement are often noted, but pure bronchial breathing is rare. The sputum may not be "rusty." This variety occurs oftenest during epidemics.

Typhoid Pneumonia.—This refers to a serious form of the disease accompanied either by marked asthenia or by "typhoid" symptoms, viz., low, wandering delirium followed by gradually deepening stupor, extreme prostration, dry and frequently brown tongue, ataxic nervous phenomena, and tympanites. The onset is rather gradual, and the physical signs may be ill-defined; or, symptoms of the lung lesion may be lacking, the diagnosis depending upon systematic examination of the chest. The condition is met with among persons already weakened by disease or alcoholism, and may follow septicemia, chronic nephritis, and diabetes mellitus.

Typhoid pneumonia is also at

times used to designate a typhoid or a pneumococcic infection of the lung occurring in the course of typhoid fever. To the former condition the term "pneumotyphoid" is more properly applicable.

Epidemic Pneumonia.—The epidemic may be widespread or restricted to a single family, tenement house, ship, jail, or other institution. The condition not infrequently complicates influenza and its course is apt to be protracted and the mortality rate high. The physical signs may be slight or resemble those of bronchopneumonia. The so-called "serous pneumonia" complicating influenza is often characterized by sweats and irregular fever, and is ascribed to streptococcic infection.

Bilious Pneumonia.—Bilious or malarial pneumonia is a form occurring especially in malarious regions, with jaundice, vomiting, and severe nervous manifestations as its most striking features.

Alcoholic Pneumonia.—Pneumonia in alcoholics is insidious in onset and exhibits a comparatively low temperature range—from normal temperature up to 102° F. (38.8° C.). Pain may be almost wholly lacking and cough slight, but the sputum is not infrequently abundant and watery, with "prune-juice" characteristics.

There is often profuse sweating, and marked nervous symptoms are quite common. Delirium may be of the muttering or the maniacal variety; or, all the manifestations of delirium tremens may occur at the onset, with entire absence of the ordinary subjective symptoms of pneumonia. The prognosis is relatively unfavorable.

Postoperative Pneumonia.—Postoperative or ether pneumonia sometimes occurs, especially after abdominal operations. The condition often presents characteristics of lobular rather than lobar pneumonia, and is frequently due to bacteria other than the pneumococcus. Its development is favored by protracted anesthesia, pre-existing coryza, bronchitis, or chronic pulmonary congestion, general weakness, the winter season, and the inhalation of irritant substances. The commonest causes of postoperative pneumonia are emboli from the site of the operation and collapse of one or more pulmonary lobes. The pneumonia is generally of short duration, and the mortality is relatively low.

As emphasized by Riesman, postoperative pneumonia may be unaccompanied by cough, chest pain, or marked increase in temperature and respiratory rate. The lesion being seldom anterior, it is important to examine the posterior thorax carefully.

Pneumonia in Children.—In children and infants a convulsion, drowsiness or vomiting often marks the onset of the disease. Delirium and stupor appear earlier and more frequently than in adults. Some cases simulate scarlet fever, with sore throat and cutaneous flush. Pain is often absent or referred to other regions of the body, sometimes suggesting appendicitis, and expectoration, with the characteristic rusty color, is rarely present. An expiratory grunt is significant. The disease is apical oftener than in adults, but this localization is frequently overlooked. The course is often shorter than in adults and the mortality in uncomplicated cases less.

A diagnosis of pneumonia can be made in children in the absence of physical signs when several of the following symptoms are present: Fever; overactivity of the alæ nasi; a pneumonic type of respiration with a pause at the end of inspiration accompanied by an expiratory grunt; a respiration-pulse ratio approximating 1:3; rigidity of the upper extremities, and an effort by the child to protect a sore chest. Routine use of the X-rays has revealed central pneumonia in the absence of physical signs. R. G. Freedman (*Arch. of Ped.*, Jan., 1920).

Pneumonia in the Aged.—The onset is usually insidious, the initial chill being often absent or replaced by less pronounced chilliness occurring repeatedly. Prostration is very marked. Pain, cough, and expectoration are slight or absent, and the physical signs are ill-defined. Death frequently occurs in the course of an apparently mild illness, owing to cardiac weakness. It may be that this is not a true pneumonia, but mainly a passive hyperemia due to failure of the sympathetic vaso-constrictors, which control the calices of the pulmonary arterioles.

Terminal Pneumonia.—Pneumonia often closes the scene in chronic nephritis, pulmonary tuberculosis, organic heart disease, diabetes mellitus, and chronic nervous diseases. No clinical evidences of the disease may be manifest other than a slight rise in the temperature and respiratory rate, and the physical signs of lung consolidation. The onset is gradual and the actual condition usually a bronchopneumonia.

Secondary Pneumonia.—This occurs in the course of many of the acute infectious diseases, and may be due either to the pneumococcus, to the organism responsible for the pri-

mary disease, *e.g.*, the typhoid or diphtheria bacillus, or to mixed infection with the common pyogenic organisms or the colon bacillus. The condition sometimes presents the characteristic features of lobar pneumonia, but is oftener a bronchopneumonia.

DIAGNOSIS.—In the majority of cases of lobar pneumonia, the diagnosis is readily made, the sudden onset with a chill, the excessive respiratory rate as compared with the pulse, the cough and rusty sputum, the herpes, the leucocytosis, the temperature curve, and the physical signs admitting of no error when collectively noticed. The association of undue dyspnea with fever should always suggest examination of the lungs; likewise, the association of fever with delirium tremens in alcoholics.

Most cases of pneumonia in infants show shifting of the heart and mediastinum to the diseased side. This is an important feature in diagnosis, to exclude pleural effusion. Wallgren (*Acta Ped.*, Oct. 15, 1923).

Report of a group of atypical cases featured by a persistent hacking cough and prolonged course. There was also absence of apical intensification of breath sounds. Sputum was almost wholly absent, except in cases complicated with bronchitis. The consolidated lung failed to convey to the stethoscope sounds produced in the bronchial tubes. C. Joyce (*Med. Jour. of Austral.*, Jan. 24, 1925).

X-ray examination reveals pneumonic consolidation as a rather faint shadow with irregular, indefinite margins. Such examination is not positive earlier than the physical signs except in central pneumonia, in which, therefore, it attains its greatest value. In general, the beginning

of resolution may frequently be detected earlier with the X-ray than from clinical evidences. It is serviceable, accordingly, for the differentiation of pneumonia from tuberculous processes, which are seen to be more persistent.

Very often the X-ray does not assist in diagnosis unless the clinical signs are also considered. It is useful for detecting a complicating pleurisy or an abscess. An early appearing and widely and rapidly spreading shadow is unfavorable. Paisseau and Iser-Solomon (*Ann. de méd.*, Jan., 1924).

The X-rays show in pneumonia in children a distinct triangle with its base directed towards the periphery and its apex toward the hilum of the lung. The triangle appears either early, after several days, or late, and disappears from one to several weeks after the crisis. It begins in the periphery, resembles an infarct, and is a sign of pneumonia with hepatization. Mouriquand (*Arch. de méd. des enf.*, Aug., 1924).

The conditions most frequently requiring differentiation from lobar pneumonia are: Bronchopneumonia, acute pulmonary tuberculosis, pleuritis with effusion, typhoid fever, and meningitis.

Bronchopneumonia.—This disease involves both lungs and lacks the definitely lobar physical signs of croupous pneumonia. Areas of dullness over which bronchial breathing and bronchophony are heard occur here and there on both sides. The onset is less sudden, a well-defined bronchitis generally preceding. There is not the characteristic rusty sputum. The disease is of longer duration and terminates by lysis.

Knowledge of the possible deviations from typical lobar pneumonia considered in the preceding section—

such deviations often tending toward the bronchopneumonic type—should prove sufficient, in conjunction with systematic chest examination, to keep one constantly on guard against oversight of the existence of a pneumonic lesion.

Acute Pulmonary Tuberculosis.—

Often the existence of this condition instead of pneumonia is not suspected until failure of the expected crisis to occur is noted, or tubercle bacilli and elastic fibers are accidentally discovered in the sputum. Among the features which should suggest tuberculous rather than pneumonic disease are: Inherited predisposition to tuberculosis; previous ill health; gradual onset; fever of the remittent or intermittent type; frequent profuse sweats; more purulent and less viscid sputum, which may be blood-tinged, but contains numerous tubercle bacilli and yellow elastic tissue; absence of herpes; rapid emaciation, and the physical signs of cavity formation. The ratio of pulse to respiratory rate is, in general, less decreased than in pneumonia. The physical signs are, as a rule, first referable to the apex instead of the base, and invasion of the apex on the opposite side usually occurs.

Pleuritis with Effusion.—Difficulty in diagnosis arises especially in cases of pleural effusion with pronounced bronchial breathing and bronchophony. The differential features of effusion are as follows: The initial chill is usually not severe, often a mere chilliness; the temperature rarely rises above 102° F. (38.8° C.); usually there is less cough and less abundant expectoration; the characteristic rusty quality of the sputum is lacking; inspection of the chest reveals a change in the contour of the affected side, with

partial effacement of the intercostal spaces; the tactile fremitus is usually absent instead of increased; the percussion note is completely dull or flat; in left-sided pleural effusion there is displacement of the heart to the right and of the fundus of the stomach downward, with resulting obliteration of Traube's semilunar space; in right-sided effusion there is displacement of the heart to the left and of the liver downward; on auscultation the breath and voice sounds in pleural effusion are usually of reduced intensity or exhibit a distant bronchial quality.

In the "coin test," an assistant strikes 2 coins together over the suspected area. The physician listens over the symmetrical point on the opposite side. If there is fluid, the sound is transmitted with a metallic clang; if normal, it is dull; if pneumonic consolidation exists, it is still duller.

When the hands are moved up and down the sides of the chest, if an effusion is present the interspaces on the affected side are flush with the ribs. There are no râles, as a rule. Tapping or the X-ray may be needed to settle the diagnosis. Riesman (Jour. Amer. Med. Assoc., Apr. 19, 1924).

Pneumotyphoid.—Differentiation of typhoid pneumonia from typhoid fever with lung involvement is often very difficult at first. It should be borne in mind that whereas leucocytosis is the rule in pneumonia, there is a leucopenia in typhoid. The result of the Widal test should be carefully noted. After the first week unmistakable symptoms of typhoid fever will appear in pneumotyphoid.

Meningitis.—Marked nervous symptoms in pneumonia at times lead to confusion between this disease and meningitis. Physical examination of the chest in all cases simulating meningitis is therefore advisable. Convulsions, while often the initial symptom

of pneumonia in children, usually occur only later in meningitis. Headache, which is frontal in pneumonia, is occipital in meningitis. Indicative also of the latter disease are: Restlessness, hyperesthesia, and exaggerated reflexes; rigidity of the neck; a lower, less regular temperature curve; a more variable and irregular pulse rate, and an absence of dyspnea and of the crisis.

Out of 145 cases in patients aged 2 to 15 years, 17.5 per cent. had been wrongly diagnosed as acute appendicitis or surgical abdomen, and 4.8 per cent., as cerebrospinal meningitis. Abdominal tenderness and spasm are relatively frequent in pneumonia, but the tenderness seems more severe and superficial, usually not well localized, and often higher in the abdomen; deeper pressure does not add to the discomfort. Spasm at times can be worked out by palpation at the end of expiration. A high leucocyte count favors pneumonia, except when peritonitis or appendix abscess is suspected. With evidences of meningeal irritation, pneumonia should be ruled out before lumbar puncture is done. F. D. Adams and B. J. Berger (Jour. Amer. Med. Assoc., Nov. 25, 1922).

ETIOLOGY.—Pneumonia prevails in all climates and occurs in all seasons, though especially during the winter and early spring. In cold weather with marked variations in temperature and humidity the incidence is greater than during protracted cold.

The disease occurs at any age, though less frequent in adolescence than at any other period. After the sixtieth year pneumonia claims more deaths than any other acute disease. Males, owing to greater exposure, are more liable to the disease than females. Sex in itself affords neither immunity nor any special predisposition to pneumonia. Negroes are more susceptible to the disease than whites.

Of 12,098 cases of pneumonia analyzed by H. E. Lewis, 73.41 per cent. occurred in males and 26.59 per cent., in females. Among 10,159 cases, the disease terminated by crisis in 5397, or 53.1 per cent.; in 1042 cases, 21.7 per cent., the crisis occurred on the 7th day; in 625 cases, from the 10th to the 17th day. Among 2613 cases death occurred as follows: Before the 4th day, 161; 4th to 12th day, 1483; 12th to 18th day, 403. The greatest number of deaths occurred on the 7th day.

Though common in individuals apparently in good health, the disease is most likely to attack those exposed to depressing influences, either physical or mental. It is especially rife among individuals weakened by fatigue, insufficient food, faulty hygienic environment, exposure to inclement weather, and alcoholism, either acute or chronic. The more enfeebled the constitution, the more asthenic, as a rule, the form of the disease. Pneumonia often follows "catching cold," owing to the associated lowering of the resisting powers; in many cases, however, no history of exposure to cold is obtainable. Traumatism to the chest predisposes to it, and likewise convalescence from certain diseases, *e.g.*, typhoid fever, influenza, nephritis, and diabetes. Among 160 cases of heat prostration, Reid found 10.7 per cent. of deaths from pneumonia.

In 90 cases of pneumonia in an infantry battalion at an army camp, the type of pneumococcus was practically always the same for any 1 tent. Carriers must therefore play an important part in transmission. Of 700 men of the same regiment, 16 per cent. harbored pneumococci, but only 3 per cent., the fixed types. To rid these carriers of pneumococci, **phenol** (3 per cent. in alcohol) and **iodine** (5 per cent. in alcohol) proved best. Sailer, Hall, Wilson and McCoy (Arch. of Int. Med., xxiv, 600, 1919).

Epidemics of lobar pneumonia are sometimes met with, due to increased virulence of the organism. In the house-epidemic form it is thought that the disease may be transmitted by contagion. No immunity is conferred by one attack, which, in fact, seems to predispose to subsequent attacks.

The exciting cause of the disease is, in 90 per cent. or more of cases, the *Diplococcus pneumoniae*, or pneumococcus of Fränkel (*Micrococcus lanceolatus*). This is a slightly elliptical coccus, united in pairs, and surrounded by a pale capsule, and was found by Netter in the buccal secretions of 20 per cent. of well persons. Its presence has also been frequently demonstrated in the nasal secretions and the Eustachian tubes. Under abnormal conditions it may be found in the blood as well as in various complicating or even independent lesions, such as pleuritis, pericarditis, endocarditis, peritonitis, meningitis, nephritis, conjunctivitis, synovitis, and acute abscess.

Bacteriologic researches have shown that four types of pneumococci may be set apart, having different agglutinative properties. The first three types, the "fixed types," are, according to workers at the Rockefeller Institute, responsible for about 80 per cent. of lobar pneumonias. Type IV is a heterogeneous group, subject to further subdivision, often more saprophytic than pathogenic, and the most commonly found in the mouths of healthy subjects, where the fixed types occur relatively seldom, except in persons in contact with pneumonia cases. Variations in the relative incidence of pneumonia due to the several types occur in different years. A general average compiled by the Pneumonia Commission of Philadelphia showed an incidence

for the four types, respectively, of 30.2, 23.5, 11.3, and 34.8 per cent., while the case mortality was, as usual, greatest for Type III (53.7 per cent.) and least for Type IV (22.2 per cent.). Type I is the commonest of the three fixed type infections, but the least fatal (24.1 per cent. mortality). Virulence seems to some extent to vary with the degree of capsule formation; thus, Type III (*Pneumococcus* or *Streptococcus mucosus*) shows the most pronounced capsule, while in Type IV capsule formation is irregular.

In infants and children, according to Mitchell, the pneumococci without definite agglutination reactions, classed as Type IV, are of more frequent occurrence than in adults, while the mortality from the fixed types seems to be lower than in adults. (For data as to the methods of "typing" pneumococci, see under TREATMENT.)

In the remaining few per cent. of lobar-pneumonia cases a pathological condition not infrequently indistinguishable from the pneumococcic form is caused by one of a variety of microorganisms, including the pneumobacillus of Friedländer, the influenza bacillus, the typhoid bacillus, streptococci, staphylococci, the diphtheria bacillus, the plague bacillus, etc. In a larger percentage of cases, however, one of these organisms is present in conjunction with the pneumococcus, usually causing an atypical course or complications.

Infection with the pneumococcus is believed usually to take place by inhalation. Transmission may occur either directly, through a third person, or by the air, less frequently by fomites. If direct infection of the blood takes place through a wound or tonsil, the lung may be infected secondarily from

the blood. There is no constant relation between the amount of lung-tissue involved and the intensity of the symptoms; a limited pulmonary lesion may be attended with high fever and great constitutional disturbance, or an extensive lesion with relatively mild symptoms. To the more or less pronounced general toxemia induced by the organisms pullulating in the lung are due these variations in the severity of the symptoms.

The importance of a predisposing cause such as low vitality or previous local irritation in the production of the disease is emphasized by the experiments of Dürck, who showed that while intratracheal injection of the pneumococcus or other bacteria alone is insufficient to cause pneumonia, the latter results when irritating dust is also injected.

PATHOLOGY.—The essential lesion of lobar pneumonia is a temporary solidification of lung-tissue due to the deposition of a fibrinous, hemorrhagic exudate in the pulmonary alveoli and bronchioles. As a result, the lung is changed from an air-containing structure to one which is airless except in the larger bronchi. The right lung is oftener involved than the left, and the lower lobes oftener than the upper. Though not infrequently bounded by the fibrous septa separating pulmonary lobes, the lesion often extends beyond the limiting surfaces of a lobe. In a series of cases analyzed by Thomas G. Ashton the involvement was distributed as follows:—

	Cases.
Right lower lobe	83
Left lower lobe	59
Right upper lobe	24
Left upper lobe	14
Right middle lobe	3
Right middle and lower lobes .	20

	Cases.
Right middle and upper lobes .	9
Entire right lung	20
Entire left lung	18
One lobe in each lung (various combinations)	10
Right upper and middle and left upper lobes	3
Entire right lung and one lobe of left	9
Entire left lung and one lobe of right	8
Both lungs in their entirety ...	1

The pulmonary tissue changes in lobar pneumonia occur in four stages: (1) congestion; (2) red hepatization; (3) gray hepatization; (4) resolution. Frequently two or more stages are met with simultaneously in different areas of the same lung:—

1. *Stage of Congestion.*—The involved tissue is markedly hyperemic, dark red in color, and denser and less crepitant than normal, though the alveoli still contain some air. The lumen of the air-vesicles is encroached upon both by surrounding engorged capillaries, swollen alveolar epithelium, and an exudate, still fluid, containing red blood-cells, a few leucocytes, and desquamated epithelium. The usual duration of this stage is twenty-four hours, but it may continue for several days.

2. *Stage of Red Hepatization.*—The lung-tissue is brownish red in color, though less congested than in the first stage, and shows a distinct increase in size, weight, and consistency. Upon the surface, indentations produced by the ribs are often observable. The tissue sinks in water and resembles hepatic tissue, whence the term "hepatization." The lung is very friable and the cut surface is dry, dull, and granular, the exudate having increased in amount until it filled the alveoli and then coagulated to a solid mass. The

exudate contains mononuclear and polynuclear leucocytes, erythrocytes, desquamated epithelium, and pneumococci. Minute casts of clotted exudate can be drawn from the small bronchi by scraping the cut surface with a knife.

3. *Stage of Gray Hepatization.*—Gray hepatization gradually develops from the preceding stage, and is the result of increased exudation of leucocytes as well as diminution of hyperemia owing to pressure by the exudate on the blood-vessels. The lung becomes grayish red, then gray, in color, and is less granular and more moist and brittle than before, owing to liquefaction of the alveolar contents through degenerative changes in the desquamated epithelium, dissolution of the red blood-cells, and transudation of serum from the vessels. Polynuclear leucocytes now constitute a large part of the exudate, which becomes more puriform in appearance. The exudate becomes more and more soft, in consequence of autolysis and disintegration of the fibrinous network, and its color disappears, owing to removal or decomposition of the coloring matter of the erythrocytes. At least one-half the fatal cases succumb in the earlier part of the stage of gray hepatization.

4. *Stage of Resolution.*—The softened exudate is removed in large part by absorption, to a less extent by expectoration. Air progressively re-enters the alveoli, and regeneration of the lost alveolar epithelium takes place from that which had escaped the processes of desquamation and degeneration. Resolution usually begins with the crisis, though sometimes later.

Where resolution fails to occur, the condition resulting may be one of dif-

fuse purulent infiltration; or, one or more abscesses may form, owing to secondary infection with pyogenic organisms. A portion of a lobe, or an entire lobe, may become gangrenous, owing to obstruction of blood-supply and putrefactive secondary infection. In a few instances pneumonia terminates in induration (chronic interstitial pneumonitis), more frequently, in tuberculosis,—the latter especially where the apex has been involved. Delayed resolution does not prevent an eventual complete return to normal.

Associated pathological conditions in pneumonia include usually some hyperemia and edema of the unsolidified lung-tissue, sometimes bronchitis, and nearly always fibrinous exudation on the adjacent pleural surface. The peribronchial and tracheal lymph-nodes are often enlarged and softened. The spleen is swollen, and the myocardium, liver, and kidneys may show parenchymatous or even fatty changes. A catarrhal state of the gastrointestinal mucosa is frequently noted *post mortem*. The heart, especially on the right side, is often greatly dilated, and may contain firm blood-clots,—due to an increased amount of fibrin in the blood,—which may have been the cause of death. W. J. Stone found right ventricular dilatation in 39.4 per cent. of 89 lobar pneumonia autopsies.

In lung infection by Friedländer's pneumobacillus, distinct disease foci may be produced in a single pulmonary lobe. Abundant mucus formation, especially in the earlier stages, imparting a slippery feeling to the finger, is a feature. The proportion of fibrin and erythrocytes to the leucocytes and desquamated epithelium in the exudate is said to be less than in pneumococcic pneumonia.

The crisis cannot be entirely explained on the basis of an immunologic reaction. From autopsy studies in 87 cases, the writers maintain that it is the result of a mechanical interference with the circulation in the pneumonic area, through the formation of fibrinous plugs and thrombi in the vessels. With the cessation of circulation, toxic absorption from the affected area ceases and the crisis results. Lysis is associated with a more gradual mechanical interference with the circulation. Ornstein and Braunstein (N. Y. Med. Jour., Apr. 18, 1923).

Out of 30 infants below 12 months of age with lobar pneumonia, in 27 the right upper lobe was affected and in 3 the left lower lobe. This predilection for the right upper lobe is manifest for the first 3 years of life. It may arise partly from a relative atelectasis of the left upper lobe. Further, this lobe, which usually remains uninvolved, has its regional lymph-nodes, not in the hilum, but outside of the lungs, in the mediastinum along the ductus Botalli and the aortic arch. S. Engel (Klin. Woch., Apr. 9, 1925).

COMPLICATIONS AND SEQUELS.—*Pleuritis.*—Acute fibrinous pleuritis is a constant accompaniment of pneumonia where the morbid process reaches the visceral pleura. In some cases, however, liquid exudation takes place (metapneumonic pleuritis). The serous fluid exuding is peculiar in that it often contains much more fibrin than that produced in ordinary pleurisy. The signs of effusion may be obscure in the presence of lung consolidation. On the other hand, the true pneumonic symptoms may be obscured by the intensity of the accompanying pleuritis (pleuropneumonia). In some instances (1 per cent. of all cases), especially in children, a purulent exudate is formed (metapneumonic empyema). Pleural complications should be thought of where there

is delayed convalescence, with chills, fever, sweats, a sudden rise in the leucocytosis, flatness on percussion, greatly augmented resistance to the percussing finger, and absence of breath sounds and of râles. A paroxysmal cough brought on by movements and often unaccompanied by expectoration may also be noted. Because of the resistance offered by the solidified lung to the accumulating fluid, a relatively slight effusion may cause serious displacement of other viscera, in particular the heart. The importance of recognizing a pleural effusion is therefore manifest, as aspiration may become necessary to relieve circulatory embarrassment. The exploring needle should, in fact, be used without hesitation where the symptoms and signs do not permit of a positive diagnosis. Whether the effusion be serous or purulent, the pneumococcus can usually be discovered in it.

Pericarditis.—This complication has been noted as occurring in 5 per cent. of a series of cases, and is met with oftenest in young adults. Though it is commonly of the fibrinous variety, there may be a considerable serous exudate, and occasionally a purulent exudate. Augmented dyspnea and an increase in the pulse rate should bring to mind the possibility of this complication, the advent of which is, however, often very insidious. Precordial pain may or may not be produced. The diagnosis is dependent upon the physical signs.

Among 300 necropsies on pneumonia patients, pericarditis occurred in 72 instances, or 24 per cent. Forty-four of these patients had developed acute purulent pericarditis, 14 had developed acute sero-fibrinous pericarditis, while 14 had developed the subacute form of fibrinoplastic or puru-

lent pericarditis manifested by the so-called "shaggy heart," or *cor vilosum*. Hydropericardium existed in 12 instances. W. T. Stone (Trans. Amer. Med. Assoc., June 12; 1919).

Arrhythmias.—Auricular fibrillation occasionally develops in lobar pneumonia. Premature contractions sometimes occur where there is excessive resistance against the heart action; the higher the cardiac rate the more serious is their occurrence. Sinus arrhythmia may be noted in children. Partial heart block, usually transient and appearing after the crisis, may at times be observed.

Endocarditis.—Acute endocarditis occurs more frequently than pericarditis, and may be simple or malignant, more frequently the latter. Any valve may be involved, but the condition is commonest at the aortic valve, and particularly attacks subjects of chronic valvular disease. Septic manifestations and evidences of embolism constitute the chief factors in the diagnosis, symptoms being generally and murmurs frequently absent. The supervention of meningitis upon endocarditis confirms the diagnosis of the latter. Endocarditis is said to occur twice as often in female patients as in males.

Case of embolic gangrene of the extremities in lobar pneumonia complicated by diabetic coma. The patient was 19 years of age, and had a sudden infarction of the entire left foot, which became cold and purplish black and later gangrenous. Two days later the terminal phalanx of the left fifth finger suddenly became cold and black, but circulation gradually returned to it in the course of 3 days. Death later occurred in spite of vigorous insulin treatment.

Among 53 recorded cases of embolic gangrene in pneumonia, exclusive of endocarditis, 25 involved one lower extremity, 6 both lower extremities,

and 11 an upper extremity. There were 11 deaths in 42 cases. Kiefer, Brigham and Wheeler (Boston Med. and Surg. Jour., Feb. 4, 1926).

Meningitis.—Acute meningitis is an occasional complication of pneumonia. Violent and persistent headache, neck rigidity, and delirium followed by stupor and coma indicate a probable meningitis, but often the symptoms are not so marked and distinction from mere "meningism" can be made only by lumbar puncture. In actual meningitis the inflammation of the meninges is fibropurulent, and death usually follows. Pneumococci may be found upon lumbar puncture in these cases.

Nephritis.—Acute nephritis occurred, according to Norris, in 1.3 per cent. of a series of 20,107 cases of pneumonia. Albuminuria and casts in the urine form the basis of the diagnosis.

Other, less frequent, complications of pneumonia include general bronchitis, parotitis, otitis media, conjunctivitis, synovitis and arthritis, toxic myocarditic degeneration, heart-clots, gastritis, acute gastric dilatation, duodenitis (causing jaundice), meteorism, enteritis, colitis, phlebitis, erysipelas, peritonitis, peripheral neuritis, and hemiplegia, either embolic or toxic. In a series of 18 cases of complicating parotitis, both glands were successively involved in 4 instances, and incision and evacuation of pus were required in 5 cases.

Among the extrabulbar eye complications of pneumonia the most frequent are those involving the cornea. Keratitis may occur in lobar pneumonia, but more often complicates severe bronchopneumonia, especially that following measles. It may assume the form of ordinary keratitis with hypopyon, interstitial keratitis, or kera-

tomalacia. Probably these are due to infection from the fingers or handkerchief in debilitated patients. Intra-bulbar complications may involve the iris, retina, or all the deeper tissues of the eye. Often the pupil on the affected side is relatively dilated. Roth's "septic retinitis" may occur. Deep involvements consist usually of suppurative iridochoroiditis (panophthalmia), less often of a plastic iridochoroiditis. The writer saw 11 cases of keratitis, 4 of iridochoroiditis, and 1 of purulent conjunctivitis. H. Villard (*Ann. d'ocul.*, Oct., 1922).

Acute pneumococcal sinusitis found a common and early complication of lobar pneumonia. Of 15 cases of pneumonia in which the nasopharyngoscope was used, 6 had signs of acute suppurative sinusitis. Of 8 cases in which anteroposterior roentgenograms of the sinuses were made, 7 had clouding of 1 or more sinuses. In a series of 16 cases, pneumococci corresponding in type to those found in the sputum were isolated from the middle fossæ of the nose in every instance. Felty and Heatley (*Jour. Amer. Med. Assoc.*, Apr. 17, 1926).

Relapse occurs in some cases of pneumonia, the temperature rising again a few days after the crisis and remaining febrile for two days to a week. As already mentioned, recurrences after more or less prolonged intervals are frequently met with.

Sequels.—If resolution is delayed for many days or several weeks, fibroid induration of the lung-tissue is a likely sequel, sometimes resulting in marked retraction of the chest wall. Purulent infiltration, another possible sequel of pneumonia, shows itself by the expectoration of large amounts of purulent material containing pulmonary elastic tissue, together with the signs of a cavity as the abscess increases in size. Gangrene of the lung reveals itself by the markedly offensive odor

of the sputum, the presence of elastic tissue, and by constitutional symptoms of infection.

PROGNOSIS.—The mortality rate of lobar pneumonia is from 15 to 40 or more per cent., the average being 18 to 30 per cent. The rate varies greatly under the influence of different factors and associated conditions, such as the severity of the infection, age, race, previous condition of health, complications, etc. Children generally recover; after the twentieth year the death rate increases gradually until old age, when the disease becomes most dangerous, with a mortality of 50 to 80 per cent. The mortality is greater in the negro than in the white race. In individuals already weakened by disease or insufficient food, pneumonia is distinctly more fatal than in the previously healthy. In alcoholic subjects death very commonly occurs. Obesity also exerts an unfavorable influence.

As regards severity of the infection in the individual case, the chief factors bearing upon prognosis are: the range of the temperature, the condition of the circulation, the intensity of toxemia, and the degree of leucocytosis. A temperature persistently as high as 105° F. is of grave prognostic import. Increasing pulse rate after the fifth day signifies cardiac enfeeblement, and lessened intensity of the pulmonary second sound, insufficiency of the right ventricle. Marked toxemia is indirectly an unfavorable prognostic factor, impairing cardiac action. Absence of leucocytosis is a bad sign, except in the very mildest cases. Delirium, if pronounced, and especially if present early in the disease, is also unfavorable. The prognosis is graver when

a large amount of lung-tissue is involved, *e.g.*, in double pneumonia. Pneumonia at the apex is more serious than at the base. The prognosis is better in cases of pneumococcic causation than in those attended with streptococcic or mixed infection. According to Fenwick, the intensity of albuminuria is of considerable prognostic value; cases beginning with a severe gastrointestinal attack are twice as likely to end fatally as those exhibiting the more usual initial chill.

Any complication renders the prognosis graver, and the earlier the complication sets in, the more the prognosis is impaired. Endocarditis—usually ulcerative—and to a much less extent pericarditis, are considerably feared as complications. Pulmonary emphysema, extensive bronchitis, abscess or gangrene of the lung, and hyperemia and edema of the uninvolved portions of pulmonary tissue, are to be looked upon with serious apprehension. Pleuritis associated with considerable effusion, or attacking the uninvolved side, is an unfavorable prognostic manifestation. Acute meningitis as a complication renders the prognosis absolutely bad.

Death in uncomplicated cases occurs frequently from insufficiency of the right ventricle, due to the increased effort demanded as a result of pulmonary consolidation, coupled with the action of the toxemia on the myocardium. Vasomotor paresis is also often a lethal condition. Death from insufficiency of respiratory function of the lungs is very infrequent. Severe toxemia, manifested not only in heart weakness, but also in the typhoid state, severe diarrhea, and tympanites, may be the cause of

death; likewise, pneumococcic infection of structures such as the endocardium, pericardium, and meninges.

TREATMENT.—The pneumonic patient should be isolated in a well-ventilated room, or better, placed wholly or partially out of doors, as on a sleeping porch or in an improvised window tent. The beneficial influence of an abundance of **fresh air** on the toxemia, febrile symptoms, anorexia, cough, and delirium of pneumonia has been definitely proved. Where out-of-door treatment is not practicable, the windows of the sick-room should be kept wide open. The temperature of the room should be about 60° to 65° F. (15.6° to 18.3° C.) or less, except if the patient be young or very old and feeble, when a slightly higher temperature may be advisable. Light woolen undergarments should be worn, to mitigate abrupt changes of temperature. An excess of covering bedclothes should be avoided, in order not to hamper the already overtaxed respiratory system by placing an obstacle to the chest movements. In open-air treatment sufficient covering should, of course, be provided to make the patient comfortable, and the head should be covered.

Children with pneumonia should be separated by glass partitions or screens to prevent bedside infection. Each room should be well ventilated with **fresh, cool air** at a temperature not below 50° F. (10° C.). While cold air has seemed helpful in raising the blood-pressure, the author has never found icy cold air of any benefit, but on the contrary somewhat of a detriment, especially in weak, exhausted children. The best results are obtained with an even temperature of from 50° to 60° F. (10° to 15.6° C.), with no sudden changes from heat to cold. Moffett (*Med. Jour. and Rec.*, Jan. 20, 1926).

The patient should, in general, be allowed to assume in bed that position in which he breathes most easily; the tendency to hypostatic congestion should, however, if possible be antagonized. A careful physical examination of the entire chest should be made on the first three days, but after the affected pulmonary segment has been satisfactorily identified, the patient had best not be raised to the sitting posture for posterior examination; the phonendoscope should preferably be slipped under the patient for this purpose. The patient should not be permitted to rise from bed until at least one week after the crisis.

In hypostatic pneumonia, in pneumonia in the stage of lysis, and in pulmonary edema, the writer advocates placing the patient in **ventral decubitus**. The foot of the bed should be elevated, in addition. The procedure is also useful in the prophylaxis of hypostatic pneumonia. Rautenberg (*Deut. med. Woch.*, Jan. 5, 1923).

In lobar pneumonia the blood chlorides are low. Supplying the lacking chloride seemed markedly to influence the course of the disease. In all cases enough **sodium chloride** should be given to keep the blood chloride at or near normal. R. L. Haden (*Jour. of Lab. and Clin. Med.*, Feb., 1925).

Rest and sleep being important factors, **morphine** or other opium derivatives should be used if restlessness is marked.

The bedclothes should be kept unwrinkled and the comfort of the patient promoted by **sponging with warm water** morning and evening, without uncovering him. Warmth of the limbs should be maintained with **hot-water bottles** or other similar means. Where sweating is pronounced, **lotion with warm alcohol**, followed by **rubbing with a coarse**

towel, may be practised. To assist in preventing skin irritation, talcum powder may advantageously be used in cutaneous folds and over surfaces exposed to friction.

An **antiseptic mouth-wash** should be ordered in pneumonia. Thorough **disinfection of the sputum** is an important measure from the prophylactic standpoint. The sputum should always be collected in suitable receptacles and either burned, treated with lysol or some similar solution, or disinfected by Finkler's method.

This method consists in adding the sputum to a solution of 3 per cent. each of borax and KOH, colored with phenolphthalein, allowing the sputum to dissolve, and adding further a solution of mercury bichloride and HCl in sufficient amount to decolorize the mixture.

Diet.—The diet in pneumonia should be nutritious but easily digested, and, in the early stages at least, chiefly liquid. Milk naturally forms an important element in the diet, though it cannot be depended upon alone to supply the calories necessary for the patient's maintenance. Such substances as barley, oatmeal, cream, and cane-sugar or milk-sugar may be added to it to increase its nutritive properties. Where raw milk is poorly borne owing to the formation of large, irritating curds, $\frac{1}{2}$ teaspoonful of dilute hydrochloric acid in 1 pint of water may be slowly added to a quart of milk, and the mixture heated to boiling with constant stirring and given to the patient in divided amounts (Elsner). The milk may also be diluted with lime-water or Vichy, or given predigested.

Meat or vegetable soups or broths rendered thicker by the addition of a small amount of flour or powdered

rice, together with white of egg or whole egg, may also be administered with advantage. Among other articles which may be well borne are cornstarch, arrowroot, strained oatmeal gruel, gelatin flavored with wine, junket, calf's foot jelly, ice-cream, water ice, grapefruit, buttermilk, kumyss, etc. All food should be given in small quantities at short, definite intervals, to avoid distention of the stomach and interference with heart action at any given period. After the crisis, vegetable purées, milk-toast, soft-boiled eggs, omelet, scraped meat, stewed or ripe fresh fruits, and, soon afterward, chicken, sweetbreads, etc., may be employed. Overtaxing of the digestive organs, however, is at all times to be avoided.

Water should be quite abundantly supplied throughout the course of the disease. Orange-juice, with or without whipped albumin, also lemonade and similar preparations may be administered. Pneumonia patients exhibit quite a high degree of tolerance for alcohol, which may not only serve as a rapidly assimilated generator of heat and a stimulant, but may increase the appetite and facilitate the digestion of food where this is imperfect. If used, alcoholic preparations should preferably be given in small, repeated amounts. The employment of alcohol in pneumonia has been diminishing, though some still use it routinely. In alcoholics its use is definitely indicated, lest collapse occur through discontinuance of an accustomed stimulant.

It is a mistake to give the patient a heavy diet during the first three or four days of illness. It should be very gradually increased as the patient seems capable of digesting it. A good combination consists of an

infusion of $\frac{1}{2}$ pound of raisins in a quart of hot water with 3 or 4 ounces of syrup of glucose, 2 drams (8 Gm.) of the **glycerophosphate** or **lactate of calcium**. The patient can drink this *ad libitum*. Milk is not always easily digested, and should be well diluted as well as boiled to get rid of the *B. coli* and other organisms. The following is cited to serve an adult in the acute stage for twenty-four hours: About 2 pints of milk, 2 or 3 pints of barley-water, whey, or plain water, 6 or 8 ounces of syrup of glucose, 4 or 5 drams of table salt, and 1 dram of the glycerophosphate of calcium. If the syrup of glucose be too sweet or mawkish, a quarter of a pound of sugar of milk can be used. Later on the patient can have peptonized bread and milk or some infants' food, broths, raw eggs, jellies, cocoa or coffee, and a few biscuits. J. Barr (Brit. Med. Jour., Jan. 10, 1914).

The purpose of the diet recommended by the author is to supply nourishment sufficient to carry the patient through the disease with a minimum of trouble for the alimentary tract. The diet during the febrile period and for three days after deferescence is as follows:—

8 A.M.: Give 7.5 ounces (225 c.c.) of a 2 to 1 mixture of milk and barley-water to which has been added 5 grains (0.3 Gm.) of **sodium chloride**. 8.30 A.M.: 10 grains (0.65 Gm.) of **calcium chloride** dissolved in 5 ounces (150 c.c.) of water. 10 A.M.: 7.5 ounces of milk and barley-water mixture. 11 A.M.: 7.5 ounces of orangeade made with the strained juice of one orange and 1 ounce (30 c.c.) of milk-sugar. 12 M.: 7.5 ounces of milk and barley-water. 12.30 P.M.: 10 grains of calcium chloride in water. 2 P.M.: 7.5 ounces of milk and barley-water. 3 P.M.: 7.5 ounces of orangeade. 4 P.M.: 7.5 ounces of milk and barley-water. 4.30 P.M.: 10 grains of calcium chloride in water. 6 P.M. and 8 P.M.: 7.5 ounces of milk and barley-water. 8.30 P.M.: 10 grains of calcium chloride in water. 11.45 P.M.: 7.5 ounces of orangeade. 11.55 P.M.: 10

grains of calcium chloride in water. Administer everything through a tube without raising the patient's head.

This prescription supplies about 38 Gm. ($1\frac{1}{4}$ ounces) of protein and fuel to the value of 1200 calories.

On the fourth day after defervescence in uncomplicated cases, the diet is modified by substitution of cooked wheat cereal, 6 ounces (180 c.c.), with milk, 3 ounces (90 c.c.); boiled rice, 6 ounces (180 c.c.), with milk, 3 ounces (90 c.c.), and milk toast, two slices, with milk, 3 ounces, for 3 of the milk and barley-water feedings respectively, and omission of the calcium chloride. On the seventh day after defervescence, or as soon as convalescence is assured, further additions are made. E. E. Cornwall (N. Y. Med. Jour., May 30, 1914).

The diet should be almost entirely liquid, consisting of egg nog, cocoa, buttermilk, tea, orangeade, orange juice with albumin, broths, ice cream, jello, and soups, with plenty of water. Later, soft food should be given, *vis.*, milk toast, coddled eggs, vegetable purée, scraped meat (chicken or squab), stewed fruits, and well cooked gruels. All should be given in small amounts, but frequently. H. T. Nippert (Minn. Med., Sept., 1923).

Medicinal and Symptomatic Treatment.—The chief indications in the average case of pneumonia are to minimize toxemia and forestall serious enfeeblement of heart action.

Toxemia.—Elimination is the chief agency at our command in overcoming toxemia. Calomel in an initial large dose or in fractional doses, followed by a **saline purgative**, is employed by many in the early, sthenic stage of the disease, serving both to empty the intestine and lower blood-pressure. Later the bowels should be kept sufficiently active to prevent absorption of any toxic material formed through fermentative processes.

Diuresis should in all cases be

maintained and enhanced by the administration of **water in large amounts**, *e.g.*, 6 pints (3 liters) per diem in an adult. **Lemon-, lime-, or other fruit-juice**, or such drugs as **potassium bicarbonate, citrate, and acetate**, may be added to it. Progressively increasing toxemia, with impairment of renal function, urgently indicates repeated **hot saline enteroclysis, hypodermoclysis, or intravenous infusion**. Sajous, calling attention to the large consumption of the body chlorides in pneumonia, and pointing to the necessity of a normal supply of salts in the blood to maintain its osmotic properties and protective efficiency, strongly urges the oral use of a **saline beverage** throughout the disease, made up as follows: *Sodium chloride*, 10 grains (0.6 Gm.); *potassium bicarbonate*, 5 grains (0.3 Gm.); *water*, 8 ounces (240 c.c.). Addition of a teaspoonful of lemon-juice to the above transforms it into an effervescent beverage, which can be offered to and is gratefully taken *in toto* by the patient every two hours. The potassium bicarbonate antagonizes acidosis. Excellent results have been obtained with this procedure by Todd, J. M. Taylor, and others.

The property of **sodium citrate** of preventing coagulation and reducing viscosity of the blood makes it doubly valuable in the treatment of pneumonia. The writer gives sodium citrate, with plenty of water, in doses of from 15 to 20 grains (1 to 1.3 Gm.) each hour, or 40 grains (2.6 Gm.) every 2 hours, sometimes more, to a full sized adult, and continued night and day until the result is attained. Occasionally, this dose acts as a purge. This should be checked by a few doses of an opiate. Weaver (N. Y. Med. Jour., Nov. 1, 1919).

Study of the fluidity of the blood with the viscosimeter in pneumonia cases appears to justify the **citrate** treatment. The blood viscosity has almost invariably been found high in pneumonia, especially in comparison with the hemoglobin values. L. Cheinisse (Presse méd., Feb. 14, 1920).

Elimination through the skin should be maintained by **sponging** the patient two or three times daily with **tepid water**.

Lobar pneumonia, as it occurs in *children*, is generally a disease with a very favorable prognosis.

The author applies **hydrotherapy**, oftenest in the form of **warm tub baths**, if the high temperature is attended by nervous symptoms. If these are not present, the temperature apparently does little damage. **Digitalis**, **caffeine** and the like are used should the occasion require, but the author depends more upon **alcohol** than any other drug of this class. Cough requires a sedative only if very annoying; opiates are then used, provided there is no marked tympanites. Counterirritation of any kind is unnecessary unless the case happens to be complicated by severe bronchitis. J. P. Crozer Griffith (Med. Times, Jan., 1914).

Cleaning out the gastrointestinal tract by an initial intestinal sweeping with **castor oil**, repeating this every second day through the disease, is one of the best measures for securing a favorable prognosis in either type of pneumonia. Other purgatives may be used, but it is well to avoid any that irritate the kidneys. Perhaps **magnesium citrate** is second best.

In febrile fibrinous pneumonia, **sponging** at regular intervals for high temperature, with **hot or cold water** is useful; the **hot sponge** is far more restful and stimulating to the heart. The writer's favorite method of counterirritation is to **dry cup** the chest over involved portions of the lung, and then apply over the entire chest **hot stupes** prepared by sprinkling

turpentine directly on steaming moist flannel. **Atropine**, given hypodermically, is the most useful drug, both as cardiac tonic and respiratory stimulant. R. N. Wilson (Jour. Amer. Med. Assoc., Jan. 24, 1914).

A successful **enema** and a drastic dose of **calomel**, followed by a dose of **magnesium citrate**, to begin with, and continuous attention to free elimination, are all that is needed in an ordinary mild case of pneumonia. If the toxemia is progressive and increasing, one should order plenty of **water**, with the addition of **potassium acetate**, **bicarbonate** and **citrate** to increase diuresis. An **entero-** and **hypodermoclysis** of normal salt solution, or the intravenous administration of 250 c.c. of 10 per cent. **dextrose** solution will assist elimination. Nippert (Minn. Med., Sept., 1923).

A conservative attitude toward artificial bowel evacuations in pneumonia advocated on the basis of two consecutive and comparative series of 134 and 216 hospital cases, respectively, in which different policies as regards artificial evacuations were followed. The difference in mortality in favor of the second series, in which the bowels were generally allowed to remain unmoved artificially during the active period of the disease, was about one-third. Evacuants were given only when some special indication arose other than omission of regular bowel movements. Also, usually, if the case was seen early and the bowels had not moved within 24 hours, an **enema** was allowed. Such conservative constipation, however, cannot be allowed if the diet includes broth, albumin water and similar culture media for saprophytic bacteria. The diet must, therefore, be strictly **lactovegetarian** (see details, pp. 547-548). Moderate vagus preponderance causes the slow pulse and low blood-pressure so commonly seen in pneumonia. The circulatory instability may be aggravated by toxemia of intestinal origin. Hence, the diet should favor acidophilic bacteria, with rigid exclusion of animal broths, egg albumin and prepared "peptonoid" food-

stuffs. It should include enough water for eliminative purposes, but not enough to strain the heart. If intestinal complications arise, the diet is reduced to water, fruit juice and salts, or to water and salts alone. In cases of unusual severity, and regularly near the expected crisis, the diet is greatly reduced. E. E. Cornwall (Med. Times, Mar., 1925).

Fever in pneumonia does not, as a rule, require active treatment. Cases with high fever (104° F.—40° C.) in the earlier stages of the disease frequently do better than those in which only a gradual rise in temperature takes place. Where, however, the temperature remains persistently above the level mentioned, corrective measures are required. In the very young, the very old, and where there is cardiac weakness, **sponging the limbs in succession with hot water**, under the covers, together with the application of **cold to the head**, is as safe as well as effective procedure. In other cases **cloths wrung out of ice-water** may be applied to the chest for two hours, with renewal every fifteen minutes; these applications may be repeated after intervals of two to six hours. Good results follow this procedure, not only in lowering of temperature, but also in alleviation of nervousness, dyspnea, and cyanosis. The reaction of the patient as well as the return of higher temperature should be considered in ordering repetition of the cold applications. **Ice-bags**, preferably those provided with a drainage-tube, or the **Leiter coil**, may be substituted for the cold cloths. Application of cold over the area of pulmonary solidification should be provided for in each instance. When the temperature has been reduced to a safe level, removal

of the refrigerant agent is generally advisable, unless pain coexists. **Cool or cold sponging** is frequently a useful measure. **Cold baths**, administered as in typhoid fever, are indicated only where hyperpyrexia and a good condition of the circulation exist or where other procedures fail. **Hot baths** have been recommended by Ortnier, Lemoine, and others. In general, tub baths are too disturbing to the patient—who needs all possible rest—to be advisable in pneumonia.

Hydrotherapy, rightly employed, is serviceable in lobar pneumonia. The writer favors **ablutions** of the front and sides of the trunk and the extremities, every 3 or 4 hours, depending on the temperature or the degree of toxemia, with a bath-mitten wrung out of water at 80° F. (26.7° C.), the water to be lowered 2° F. (1.1° C.) at each subsequent bath until the temperature is 70° F. (21.1° C.). During the intervals, in the severer forms, a **compress** extending from the clavicles and axillæ to the pubes and covering both the anterior surface and sides of the trunk, wrung out of water at 70° F. and covered with flannel, may be used. There is no objection to a combination of the cold air treatment and hydrotherapy, if the sick-room is closed during the cold water applications. J. M. Anders (Jour. Amer. Med. Assoc., July 26, 1924).

When, in pneumonia in children, there is high temperature, regular **sponge baths** every 3 hours with water at 100° F. (37.8° C.), combined with an **ice-bag** to the head and a **hot water bag** to the feet, will reduce the fever by 1° to 2° F. and allay much of the restlessness and delirium. The writer has never found antipyretic drugs necessary. Daily use of 5 per cent. **sodium bicarbonate** solution as a **rectal irrigation**, assisted by mild **cathartics**, relieves much of the extreme toxemia and restlessness. A liberal amount of forced feeding should be persisted in, *e.g.*, milk, egg-nogs,

white of egg with orange juice, cocoa, thin cereals and purée or creamed soups. Nourishment should be given at regular intervals, with insistence on **cooling fluids** between the feedings to obtain further elimination of toxemia. Moffett (*Med. Jour. and Rec.*, Jan. 20, 1926).

The use of antipyretic drugs such as antipyrin and acetphenetidin in pneumonia is to be avoided because of their tendency to depress the heart. **Quinine** in large doses may be tried.

Application to the chest of a mixture of 10 Gm. (2½ drams) of **salicylic acid** in 90 per cent. alcohol with 10 Gm. (2½ drams) of **castor oil** is recommended by Aquino, of Buenos Aires. The skin is first washed with ether and then 1 or 2 spoonfuls of the solution are applied on gauze and the whole covered with cotton and rubber tissue, held by a bandage. The dressing is renewed 3 or 4 times a day. Heart tonics and enemas are always given, together with an alkali internally to prevent irritation of the kidneys. Early defervescence is asserted to result from this treatment.

The writer recommends application of **wet packs** to the chest wall with a counterirritant solution composed of 3 c.c. (¾ dram) of **turpentine** and 5 c.c. (1¼ drams) of **spirit of camphor** in 1 liter of water, repeated every 2 or 3 hours. Two hygienic conditions are indispensable—**pure air** and sufficient **humidity** to avoid the fatigue involved in expectorating scanty, tenacious sputum. **Collargol** gives excellent results when administered by mouth in glycerin and egg albumin. A. Arteaga (*Rev. españ. de med. y cir.*, Apr., 1919).

Chill.—Treatment of the initial chill, when the patient is seen at this stage, consists in the use of a **hot mustard foot-bath** (given with the patient in recumbency), the external application of **heat** by means of **hot-water bags**, and the **ingestion** of a cupful of **hot water** to which ½ fluidram (2 c.c.) of **aromatic spirits of ammonia** has been added.

Pain.—For the initial pain in the side, if severe, a hypodermic injection of ⅙ grain (0.01 Gm.) of **morphine** may be given. More frequently, however, the pain, not being of an agonizing character, will be subdued by the hypodermic administration of **codeine phosphate** in the dose of ⅓ grain (0.03 Gm.). In relieving the pain these drugs will tend to enhance the circulation in the lungs, and will also lessen dyspnea and promote rest. Caution in their use is, however, demanded where the bronchi are already filled with secretions, as from associated bronchitis.

Other effectual measures for relieving the initial pain include the application of 20 or more **dry cups** on one or both sides of the chest, front and back; use of the **ice-bag** or of **Leiter's coil**; **strapping** the affected side, the plaster being overlapped and extended beyond the midline both anteriorly and posteriorly; light application of the **thermocautery**, and, as recommended by Elsner, the use of absorbent cotton impregnated with 2 fluidrams (8 c.c.) of **compound mustard liniment**, applied to the affected side for fifteen to twenty minutes. **Tincture of opium** or **Dover's powder** may be substituted for morphine or codeine. The use of the cotton jacket is an obsolescent measure, probably more useful as a placebo than for any actual benefit conferred.

Where pleuritic pain shows a tendency to persist, **cupping** may be repeated several times, every 6 or 8 hours. It may serve also to relieve dyspnea and oppression. In children, small doses of **tincture of ipecacuanha** and **opium** may be used with advantage, and in adults the same preparation used in average doses, or small

amounts of **morphine** given. In old or weak patients who are not comforted by cold applications, dry heat in the form of **hot water bags** or flannels may be substituted.

Cough.—Cough in the early stages of pneumonia will be controlled by the measures already recommended for pain. Later in the disease, where cough is annoying and expectoration scanty, agents such as **ammonium chloride**, **terebene**, and the preparations of **antimony** (in small doses) are sometimes of value. For cough and excessive expectoration during convalescence, **compound tincture of benzoin**, given in 20-drop doses on sugar with a small quantity of water three or four times a day, is recommended.

Following treatment used in 68 cases with a mortality of 13.2 per cent.: **Fresh air**, with protection from exposure to cold. **Tepid sponging** only for excessively high fever. **Fluid and lactovegetarian diet**. **No cathartics or enemas** unless special indications for them appear. For tympanites not relieved by diet reduction, a **simple** or **fel bovis enema**. In children, a dose of **castor oil** early in the disease. On the second day after defervescence, an **enema** if required. Heart stimulation only when needed: **Tincture of strophanthus**, 1½ to 3 minims (0.1 to 0.2 c.c.) every 4 hours, or **amorphous strophanthin**, $\frac{1}{1000}$ to $\frac{1}{250}$ grain (0.00006 to 0.00025 Gm.) every 4 hours by deep hypodermic injection or sublingually. As accessory heart stimulants: **Strychnine sulphate**, $\frac{1}{400}$ grain (0.001 Gm.) every 4 hours by mouth or hypodermically, and **caffeine sodiobenzoate**, 2 grains (0.13 Gm.) every 4 hours. For severe chest pain early in the disease, **hot poultices**, and even **opiates** in small doses. No opiates in the later stage. No expectorants. For delirium, constant watching and physical restraint; **sedatives** only exceptionally. In the aged and alcoholic, **whisky** in small or moderate

doses. Cornwall (N. Y. Med. Jour., Nov. 15, 1922).

Acetylsalicylic acid is valuable in pneumonia, but the doses should not be large. A case is cited in which just after the crisis, with normal temperature, intense dyspnea supervened, due to acidosis. **Sodium bicarbonate** by mouth and rectum stopped the dyspnea in a few hours and the child made a normal recovery. **Quinine** is also helpful, especially in post-influenza cases. The writer had good results with **creosote**. **Ipecac** and **potassium iodide** may be useful in loosening expectoration. **Oxygen** should always be kept ready. As a sedative at night, **Dover's powder** is one of the best agents. In cases of intense poisoning, **Warburg's tincture** is very valuable, given by mouth or rectum; besides being a bactericide, it is a strong stimulant. It must be given in alcoholic solution, since water precipitates the resins and destroys its efficacy. Hyperpyrexia should be treated by **ice sponging** or **packing**, and by large doses of Warburg's tincture. If the pulse rate is above 100, **digitalis** should be given regularly, but not in very large doses, and if it is up to 120, hypodermic injections of **strophanthin** should be given. **Camphor** hypodermically is also very effective. W. Broadbent (Lancet, Jan. 5, 1924).

Circulatory Conditions.—During the stage of pulmonary congestion the clinical manifestations may suggest the existence of abnormally high blood-pressure. Free **purgation** and **diaphoresis** will tend to overcome this, but in some instances the desirability of **venesection** will have to be considered. Indications for the latter measure are present chiefly in robust individuals with a bounding pulse, headache and restlessness ("sthenic" cases), as well as in plethoric, flabby patients early exhibiting a tendency to failure of the right side of the heart, as shown by dyspnea, cyanosis,

dilatation of the cutaneous venules, and contracted pupils. The amount of blood to be removed ranges from 8 to 20 ounces (240 to 600 c.c.), the smaller amount being not infrequently sufficient. Where present, symptoms due to toxic action on the brain are likely to be relieved by the venesection. This measure is, however, inadvisable in the debilitated.

Substitutes for venesection include the use of **veratrum viride**, **aconite**, **nitroglycerin** or **sodium nitrite**, and **bromides**. Some American physicians have, indeed, extended the use of **veratrum viride** to all cases, with the idea of relieving pulmonary congestion through dilatation of the splanchnic vessels and consequent derivation of blood from the lungs into the abdomen.

The manner of administering **veratrum viride** is illustrated in the following procedure, advocated in 1911 by T. G. Stephens: *Tinct. veratri viridis* (Norwood's), f3j (4 c.c.); *Vini ipecacuanhæ vel Spts. æthylis nitratis*, f3ij (8 c.c.). M. Sig.: Give every three or four hours in a little water, commencing with 10 drops and increasing by 1 or 2 drops at each dose. Or, *Tinct. veratri viridis* (Norwood's), *Syr. scillæ comp.*, of each f3ij (8 c.c.). M. Sig.: Give every three or four hours in a teaspoonful of syrup of Tolu, commencing with 10 drops and increasing by 1 or 2 drops at each dose. In 100 cases of croupous pneumonia this treatment was followed by recovery in 93 instances. The greatest benefit is in the stage of engorgement. The drug, according to this author, rapidly controls the inflammation, preventing extension and complications.

In place of aconite and **veratrum viride**, Marvel has recommended the use of **mustard foot-baths**, to be given with the patient prone in bed and disturbed only sufficiently to raise the feet into the foot-tub or pail.

Of far greater importance as regards the outcome of pneumonia cases, however, is the circulatory depression not

infrequently appearing at the height of the disease and ascribed to the action of the toxins circulating in the blood on the heart muscle and vasomotor centers. Few clinicians now give circulatory relaxants at the onset of lobar pneumonia, attention being concentrated rather on forestalling a later cardiovascular depression by the early administration of drugs stimulating to this system.

Since the circulatory depression often sets in with relative suddenness and may rapidly carry off the patient, its early detection, not only by ordinary methods of cardiac and pulse examination, but by systematic use of the sphygmomanometer, is of marked significance. Blood-pressure readings should, if practicable, be taken several times each day, and from comparison with the rate and quality of the pulse, an estimate of the general state of the circulation made. According to Gibson's rule, circulatory stimulation should be begun whenever the systolic blood-pressure, expressed in millimeters of mercury, falls below the pulse rate per minute. Any pressure considerably below normal is to be considered ominous, especially if a sudden drop has taken place. From the strictly cardiac standpoint, an accelerated, feeble pulse, weakening of the first sound of the heart, and loss of the pre-existing accentuation of the second sound, are unfavorable signs. In the absence of a blood-pressure record, stimulation should be begun as soon as the slightest tendency to heart depression is noted. In the presence of conditions manifestly making unusual claims upon the heart, *e.g.*, abnormally full, hard pulse, excited heart action, strong precordial pulsation, and severe dyspnea, it is perhaps

better, as advised by Ortnier, to anticipate heart weakness than to await its occurrence. The drugs chiefly used are **digitalis**, **caffeine**, **strychnine**, **epinephrin**, **alcohol**, **camphor**, **strophanthus**, and the "diffusible" stimulants, in conjunction with **saline solution**, and **venesection** or **nitroglycerin**, according to indications.

Strychnine has proven serviceable under many circumstances, and may be given hypodermically, at first in moderate, then in large doses, *e.g.*, $\frac{1}{15}$ grain (0.004 Gm.), or in smaller amounts at short intervals. By an increasing number of practitioners, however, strychnine is being less highly regarded than formerly.

Digitalis tincture, 10 to 20 minims (0.6 to 1.2 c.c.), three or four times daily, with or without **belladonna tincture**, 5 to 8 minims (0.3 to 0.5 c.c.), is of marked value where the heart is giving way to increased pulmonary pressure in the later stages of the disease. Digitalis is especially indicated where the pulse is rapid, small, and at times arrhythmic, but is contraindicated where cardiac conductivity is impaired. Other evidences of impaired heart-action are weakening of the first sound and the second pulmonic sound, distention of veins, cyanosis, rapid breathing and enlargement of the areas of cardiac and hepatic dullness.

The **infusion of digitalis** in doses of 2 fluidrams (8 c.c.) three or four times a day, or such preparations as **digitan** and **digifolin**, readily used hypodermically, may be substituted for the tincture. In cases coming under observation with the right heart already engorged, Elsner recommends frequently repeated large doses of digitalis as a life-saving measure.

In 34 lobar pneumonia autopsies the following conditions were found: Heart muscle normal, 20.6 per cent.; parenchymatous degeneration, 52.9; fatty degeneration, 11.7; leucocytic and round cell infiltration, 8.9; hyaline degeneration, 2.9, and interstitial myocarditis, 2.9. Dilatation of the right ventricle was believed often to have been the cause of death. Among 213 lobar and bronchopneumonia patients without sepsis not treated early with **digitalis**, the percentage of deaths believed associated with cardiac failure was 25.8, while among 709 cases given digitalis early it was 10.7. The routine practice is to give a full digitalis dosage within 26 hours after admission. Of a **tincture** standardized by the Hatcher cat method a patient weighing 160 pounds is given 4 c.c. (1 dram) every 4 hours for 6 doses. When further treatment is necessary **digitan** is given **intravenously** 4 or 5 days later. Caution is enjoined, however, in elderly patients with fibrous myocarditis. W. J. Stone (*Amer. Jour. Med. Sci.*, May, 1922).

Digitalis should be given before the heart muscle is either in a state of inflammation or degeneration. In the pneumonias of infants and children, the writer employs the drug infrequently, but as age increases, he uses it with increasing frequency and dosage. As a rule, in adults, he gives 15 or 20 minims (0.9 to 1.25 c.c.) of the tincture every 2 or 3 hours for the first 24 hours, followed by a rapid reduction unless the case demands otherwise. In cases of known cardiac defect, he often digitalizes by the rapid method, 30 or 40 minims (1.8 to 2.4 c.c.) being given 3 or 4 times daily until digitalis effects are produced. When the muscle irritability appears impaired, **strychnine** may be used with the digitalis. **Caffeine** is the drug of second choice. It should not be used in active delirium nor where sleep appears very necessary. **Camphor** is also very useful, intramuscularly or subcutaneously. **Adrenalin** is used in cases with marked hypotension that appear to be going into shock or collapse. Harlow Brooks (*Northw. Med.*, Jan., 1923).

It is too late to administer **digitalis** when there are already signs of a failing heart. The author therefore gives daily doses corresponding to 0.2 or 0.3 Gm. (3 to 5 grains) of standardized leaf. These do no harm even if continued for 8 to 12 days or longer. **Strychnine** is a good vasotonic. Large doses of **camphor** should also be given daily. **Caffeine** may be added in grave cases. Jagic (Wien. klin. Woch., Jan., 1925).

Caffeine strengthens the circulatory muscle-tissue, causing some acceleration of heart action, and promotes diuresis. It may be given by hypodermic injection of the **caffeine sodio-benzoate** in doses of $1\frac{1}{2}$ to 5 grains (0.1 to 0.3 Gm.) every three to five hours, or in the form of **strong coffee** by rectum.

Saline enteroclysis or **hypodermoclysis** is particularly indicated where caffeine is systematically used, to make up for the fluid lost through diuresis, but is, in general, very useful where the blood-pressure is falling and there is increasing toxemia. For rapid effects, saline solution may be given **intravenously**; but if there is pronounced heart weakness this should be preceded by venesection.

Epinephrin (adrenalin) may be given in doses of 5 to 20 minims (0.3 to 1.2 c.c.) of the 1:1000 solution (diluted) every one to three hours by intramuscular injection or with saline solution administered under the skin. It acts powerfully in raising blood-pressure and relieving splanchnic congestion, and is of great value in carrying patients through a critical period of circulatory depression.

When the pulse rate equals or exceeds the blood-pressure in millimeters, 2 to 5 grains (0.13 to 0.3 Gm.) of **caffeine** should be given hypodermically every 4 or 6 hours. Where further evi-

dences of vasomotor failure appear, 15 minims (0.9 c.c.) of 1:1000 **adrenalin** solution should be given in addition, intramuscularly, every 2 or 4 hours. Butler (L. I. Med. Jour., Aug., 1912).

Value of **adrenalin** urged in pneumonia in infants. In 60 cases the writer made 4 to 8 injections a day of 0.2 c.c. (3 minims) of the 1:1000 solution. The longest course of adrenalin treatment in any case was 8 days. The mortality in dispensary cases was 13.5 per cent., as against 45 per cent. without adrenalin. Vogl (Arch. f. Kinderh., Oct. 16, 1920).

The writer recalls the life-saving use of **adrenalin** in *senile pneumonia*. After a brief reaction to the infection, these cases show a rapid fall of arterial tension, rapid pulmonary edema, and profound exhaustion. To treat such patients in the same manner as young people is to court death, according to Sajous. They need stimulation from the start, including slowly administered intramuscular injections of small doses, 8 minims (0.5 c.c.), in saline solution, repeated as needed. F. E. Stewart (Amer. Med., Jan., 1922).

Camphor is given hypodermically in doses of 2 to 5 grains (0.13 to 0.3 Gm.) every one to three hours, dissolved in 5 parts by weight of sterile cottonseed or olive oil. Combined with **digitalis** or **caffeine**, camphor is by some highly regarded as a cardiac stimulant in pneumonia.

Strophanthus may be substituted for **digitalis**. **Strophanthin**, in particular, has been used with success as a rapidly acting circulatory tonic when injected intravenously in doses of $\frac{1}{130}$ to $\frac{1}{65}$ grain (0.0005 to 0.001 Gm.). The latter method should, however, not be used after **digitalis** has already been thoroughly tried out, as dangerous cumulative effects may follow.

The so-called "**diffusible stimulants**" are of value to maintain heart action

through a period of excessive strain, but must be administered at short intervals, *e.g.*, every fifteen minutes, if a sustained effect is required. Elsner has recommended the following combination for this purpose:—

R *Spiritus ætheris compositi*,
Spiritus ammoniæ aromatici,
Spiritus lavandulæ compositi,
Tincturæ valerianæ ʒ xv (1 c.c.).

M. Sig.: To be given every fifteen minutes.

(Where, as is rarely the case, the stomach rebels, the first ingredient is replaced by whisky or the amounts of the ammonia and lavender preparations doubled.)

Other available stimulants are: **atropine**, administered hypodermically to raise the blood-pressure and to antagonize pulmonary edema when present, **ammonium carbonate**, and **pituitary solution**.

The most useful drug is **ammonium carbonate**, 5 grains (0.3 Gm.) every 4 hours for adults; 1 grain (0.06 Gm.) for infants of 1 year. Owen (Brit. Med. Jour., June 17, 1922).

Alcohol, though its use is advised by some from the beginning of cardiac depression, had probably better be avoided, or used only in critical periods. Its action as a peripheral vasodilator should always be borne in mind. Experiments indicate that it decreases cardiac efficiency. It may be given in the form of **whisky** or **brandy**, ½ fluidounce (15 c.c.) every three hours, or as **champagne** or **Tokay wine**, ½ fluidounce (15 c.c.) every half-hour.

Nitroglycerin, essentially a vasodilator drug, is indicated only where the heart is overburdened through the resistance to blood-flow offered by narrowly contracted or sclerosed peripheral vessels.

Venesection may yield good results

when marked cardiac dilatation and cyanosis occur. It may be followed by subcutaneous or intravenous introduction of **normal saline solution** to which **epinephrin** has been added.

In cases where venesection is useless on account of heart weakness, the author urges **arteriotomy**, the radial artery being opened to relieve the dilatation of the right heart. He finds it life-saving in such cases. T. Gluck (Münch. med. Woch., Jan. 13, 1922).

The fact should not be overlooked that in vasomotor depression such measures as **cold sponging**, **mustard foot baths**, and **fresh air** may be equally as effective as drugs administered internally.

Respiratory Conditions.—Insufficient respiratory ventilation, due to loss of function of a considerable portion of the pulmonary surface through consolidation, may be antagonized, when so marked as to give rise—in conjunction with poor circulation—to cyanosis, by hypodermic administration of **strychnine**, **atropine**, etc., which will excite the respiratory centers to greater activity and tide the patient through a critical interval. Of more direct value, however, is the **inhalation of oxygen**. Clinical tests have shown that the customary procedure of inhalation of this gas from a funnel is extremely inefficient, so little of it reaching the patient's respiratory tract that only a small fraction of the possible benefit is obtained. Some sort of face-mask should, therefore, be obtained or improvised for its administration, or a tube passed into the patient's nasal tract. Oxygen tents or chambers have also been used, but are difficult to apply in the average case.

Oxygen therapy removes one of the obstacles to be surmounted on the road

to recovery, and when it is properly given one may look usually for improvement in cyanosis and the patient's psyche, and slight reduction in pulse rate and at times in the respiration rate. This may be just enough to tide the patient over his critical days until he has established sufficient immunity to master the infection. Binger (N. Y. State Jour. of Med., Oct. 15, 1925).

Hypodermic injections of oxygen have been highly recommended by French observers. This procedure is readily carried out by disinfecting the skin over the external aspect of the thighs with tincture of iodine, and passing under it through a sterile needle a current of oxygen filtered through sterile absorbent cotton. Large amounts of the gas can thus be slowly introduced without the least untoward result.

Nervous Conditions.—Sleeplessness in pneumonia may be met by **hydrotherapeutic measures** and by the administration of **carbromal**, **barbital**, **Dover's powder**, or small doses of **morphine**. For delirium, **chloral hydrate** in average doses may be given provided there is no especial circulatory depression at the time. In other instances, small doses of **codeine**, **morphine**, or **scopolamine** may be given. The last-named remedy should not be repeated if delirium continues or is augmented after the first dose. Not infrequently remedies given to improve the circulation will reduce delirium and other nervous phenomena. An **ice-bag** to the head is useful. Where the symptoms so increase as to simulate meningitis, **lumbar puncture** is likely to prove beneficial. Musser, Jr., and Hufford had success with lumbar puncture performed specifically for delirium.

Prompt, energetic treatment for *serous* or *suppurative meningitis* in pneumonia advised. The writer uses **hot baths** every 4 to 6 hours, or **hot packs**; **bromides** or **chloral hydrate** for restlessness, and **camphor** if torpor is present.

Lumbar puncture may relieve, but in the serous cases repetition of it is of no great service. In the suppurative cases it should be repeated daily; spinal injection of **serum** is perhaps of value. Nobécourt (Bull. méd., Mar. 12, 1921).

Special Remedial Measures.—**Quinine.**—Quinine is recommended in particular by Solomon Solis-Cohen, who regards it as an agent of passive immunization, destroying pneumococci and neutralizing the pneumonia poisons. He administers full doses of **quinine dihydrobromide** or, occasionally, of **quinine and urea hydrochloride**. The initial dose for an average adult is 10 to 15 grains (0.6 to 1 Gm.) intravenously; 15 to 25 grains (1 to 1.6 Gm.) intramuscularly, or 25 to 30 grains (1.6 to 2 Gm.) by mouth. The intravenous route is most effective. The aged and feeble receive one-third less than the amounts cited. The second dose, three hours after the first, is equal to or less than the first, according to the effect upon the temperature. Upon intravenous use the drug may not have to be repeated for six hours. The third dose follows the second in three or four hours, and is commonly one-third or even one-half less than the first. In general, the attempt is made to bring the temperature to normal and keep it there. The normal having been reached, 10 grains (0.6 Gm.) by mouth every four or six hours may be sufficient to maintain the effect. If not, repeated intravenous or intramuscular injection is resorted to if required. Intramuscular injections are given deeply—not in the biceps or elsewhere in the vicinity of nerve trunks. The skin is painted with tincture of iodine, and the puncture sealed with collodion.

The effect of the quinine treatment consists in a progressive and

In the Seibert camphor treatment of pneumonia, a 30 per cent. preparation of camphor in oil of sesame is used. In preparing the remedy the oil to be sterilized should be put in a bottle with a loosely fitting stopper, the sterilization taking place in a boiling-water bath. Whenever the preparation is to be used it should be drawn (not poured) into the sterilized syringe, care being taken to prevent loss of camphor by volatilization. As soon after the initial chill as possible, 10 c.c. or $2\frac{1}{2}$ drams (equal to 36 grains of pure camphor) per 100 pounds of body weight should be injected hypodermically. This should be repeated every 12 hours except in bilateral pneumonia and in severe toxemia, in which case the injections should be given every 6 to 8 hours. The injection should be given at the outer thigh or the abdomen. The point of injection should be carefully sterilized by washing and application of tincture of iodine. The injection should be made slowly and the oil gradually deposited below the subcutaneous fatty tissue and not into it. If these simple precautions are carried out, there will be no trouble either in the form of abscess, sloughing of the skin, or immediate discomfort following the camphor injections. W. J. Cruikshank (New York State Jour. of Med., Feb., 1914).

The following treatment of 1020 cases of pneumonia gave a 1.3 per cent. mortality. Absolute **rest in bed** even in mild cases. **Wards kept warm** and patients protected from draughts. No control of fever by hydrotherapeutic measures. On entering, the patient was given **Dover's powder**, $2\frac{1}{2}$ to 5 grains (0.15 to 0.3 Gm.) and **quinine**, $2\frac{1}{2}$ to 5 grains, repeated every 4 hours, often discontinued on account of nausea. On the appearance of signs of consolidation, **camphor**, 36 grains (2.3 Gm.) in **sterile olive oil**, was given **intramuscularly** every 8 hours in men and every 10 hours in women. In the severe types this dose was given as often as every 4 hours for 4 doses and then every 8 hours. Some pa-

tients received as much as 800 grains in 7 days. In the severer cases that did not respond to the camphor, a transfusion of **citrated blood** from convalescent patients was practised, or **normal horse serum** was given. Stine (Mo. State Med. Assoc. Jour., Jan., 1919).

The writer gives the average patient a daily dosage of 108 grains (7 Gm.) of **camphor** during pneumonia until the temperature is normal. There results prompt disappearance of the evidences of toxemia, *viz.*, dyspnea, restlessness and delirium, and marked comfort of the patient. In well-established pneumonia, where toxic damage is already done and consolidation well advanced, the effects are disappointing. The treatment has, however, kept the writer's mortality in lobar pneumonias well below 2 per cent. and in post-influenzal pneumonias, down to 3.4 per cent. in over 500 cases. Stine (Mo. State Med. Assoc. Jour., Nov., 1924).

Digitalis.—Full doses of digitalis have been recommended by Petresco as a means of aborting the disease. The dosage employed was 1 to 2 drams (4 to 8 Gm.) of powdered digitalis-leaves per diem. The method has not found favor, having seemingly increased rather than decreased the mortality.

Treatment of pneumonia by **diathermy** advocated. The apparatus used must deliver a d'Arsonval current of good quality and up to 2000 ma., a machine showing a high meter reading with a comparatively low spark-gap being preferable. The physiologic effect of diathermy is to produce a temporary active congestion, dilating the capillaries and increasing the speed and volume of the local circulation. In febrile conditions, such as pneumonia, there is little further increase in temperature during treatment, and blood-pressure is slightly reduced. The author's patients were merchant seamen averaging about 35 years of age. In the group treated by diathermy the

death rate was 20 per cent., while in a similar control group, treated without diathermy, it was 42.9 per cent. In a number of cases treated outside the hospital the average mortality was less than 12 per cent. H. E. Stewart (R. I. Med. Jour., Oct., 1923).

Intramuscular injections of **sodium nucleinate** recommended in lobar pneumonia. The preparation used comes in ampules of 2 c.c., 1 c.c. containing 0.05 Gm. ($\frac{3}{4}$ grain) of the nucleinate. In every case so treated, a crisis occurred 48 hours or so after the first dose, regardless of the day of administration. Of 53 cases, all responded to treatment except 8. The drug calls out the reserves of leukocytes in the marrow, thereby precipitating the devolution of the disease. Its action is greatly facilitated by alkalization with large doses of **sodium bicarbonate**. F. M. Gardner-Medwin (Brit. Med. Jour., July 12, 1924).

(For the treatment of pneumonias with **mercurochrome**, see under BRONCHOPNEUMONIA, Vol. II.)

Specific Treatment.—Pneumococcus Vaccine.—Some evidence has been accumulated that the pathological conditions due to an acute pneumococcic infection can be mitigated by the subcutaneous injection of killed bacteria of the species responsible for the disorder. Although the effects of vaccines have varied in the hands of different observers, a gradual improvement in the results obtained has been claimed. Leary, in a series of 83 cases, including many severe ones, had a mortality of only 8, or 9.7 per cent. G. W. Norris has called attention to the fact that if a stock vaccine is used, one should be reasonably sure that pneumococcic infection actually exists. Sudden onset with chill and pain in the side, high leucocytosis, herpes, rusty sputum, and the presence of the pneumococcus in the sputum constitute fairly good evidence of a pneumo-

coccic infection, where one is unable to secure a blood-culture or time is lacking. Preparation of an autogenous vaccine from a blood-culture, though more accurate, requires laboratory facilities and involves the risk of having the first culture prove sterile.

Saline vaccines may be prepared so that every c.c. contains 250 millions of each of the 4 types of pneumococci; the first dose may be 0.1 c.c., followed by further injections daily or on alternate days in gradually increasing amounts until 2 to 4 doses have been given (Kolmer).

Vaccine treatment, to yield optimal results, should be begun as soon as the diagnosis is made. According to Bispham, marked relief from pain and dyspnea is generally procured by vaccine treatment.

The writer had a number of cases in which **vaccine** was given within a few hours of the initial chill, and the whole process was over in 48 or 72 hours. The best method is to give a **polyvalent stock vaccine** of the pneumococcus and streptococcus, of each 30 million, as early as possible. Make sputum smears and cultures—blood-cultures in early cases, lung puncture in late ones—and proceed to the preparation of an autogenous vaccine. If there is no definite response in 24 or 48 hours, repeat or preferably give an autogenous vaccine. If there is no response in 36 or 48 hours, double the dose. If there is a response, as evidenced by improved clinical symptoms and signs, defer reinoculation 3 days, or until the first symptoms of retrogression in the general condition or physical signs occur. Maintain the dosage or increase it every 2 or 3 days until the patient is well. Generally about 3 doses are necessary. H. A. Craig (Med. Rec., Dec. 27, 1913).

Vaccine treatment gives more decided results than serum, and is free from

its unpleasant effects. A rapid deferescence may occur upon injection of a suitable dose of vaccine within 24 hours of the onset. The writer uses a vaccine made from primary cultures or at most first subcultures. It should not be detoxicated or sensitized. The proper dose is 100 millions of pneumococci of several strains for an adult, and 10 to 20 millions for a child of 2 or 3. This can be repeated daily. If the injection is delayed until the fourth day, little is to be expected from it. Wynn (*Lancet*, Sept. 2, 1922).

Some observers have reported excellent results from active immunization in young, robust subjects, promptly treated. The writer's own experience does not lead him to depend on it as an exclusive measure, but he sees no reason why it cannot be added to other means of defense. The **serobacterins**, introduced by Besredka, consist of bacteria treated with immune serum. An uncertain amount of antibody adheres to the microbes, and it has been urged, with some justice, that these preparations combine the merits of active and passive immunization. The author prefers them to the simple bacterins. S. Solis-Cohen (*Ann. of Clin. Med.*, Sept., 1923).

Pneumococcal **vaccine** has been used regularly by the author for 15 years as opportunity offered, and though he has had cases in which the treatment seemed ineffective, he feels that every incipient case of pneumonia or doubtful "influenza" should be treated with vaccine without delay. A medium dose of stock vaccine is free from risk, and appears to be of decisive value in many incipient cases. An autogenous vaccine can be used later if required. An early blood culture is of value for type diagnosis, for the earliest possible preparation of an autogenous vaccine, and as a basis for reliable estimation of the utility of vaccine treatment. A septicemia is probably always present during the first few hours of pneumonia, then usually disappearing in a day or two in cases of moderate severity. J. S. Dick (*Lancet*, Nov. 28, 1925).

Where lung consolidation is due to the bacillus of Friedländer, streptococci, etc., or where these organisms complicate a pneumococcic consolidation, corresponding vaccines should be used.

Rosenow has found it possible, by partial autolysis of pneumococci in salt solution, to separate from the virulent organisms a large portion of the useless toxic material contained in their bodies, leaving in them that part which stimulates antibody formation. By using such a preparation antibody formation can be excited more promptly and energetically without the production of an initial "negative phase." A much larger number of bacteria can be injected than in the case of those merely killed by heat. The autolysis is interrupted when almost all the cocci have lost their affinity for the Gram stain. In a series of 146 cases—nearly one-half had alcoholics—from 10 to 15 *billion* of the autolyzed organisms were given daily till the temperature reached normal. The mortality was 23.2 per cent. In 148 similar control cases, not given the vaccine, the mortality was 37.8 per cent. (See also **BACTERIAL VACCINES**, Vol. II.)

Antipneumococcus Serum.—This agent is indicated more especially in cases of infection with Type I pneumococci, in which favorable results appear to have been obtained. The serum must be begun early, as in late cases it seems practically ineffective.

Previous to serum injection, the patient's history should be gone into as to earlier serum administrations or asthma, and a test made by injecting 0.02 c.c. of sterile horse serum, diluted 1:10 with normal saline solution, intradermally, with a control of saline

solution, and noting whether, in a few minutes, an urticarial wheal appears. If hypersensitiveness exists, desensitization may be effected by injecting intravenously 5, 10 and 20 c.c. of a 1:50 dilution of the serum at 2-minute intervals (B. Ballet).

If used, serum requires to be given by slow intravenous injection from a large syringe or by the gravity method. The usual initial dose is 90 to 100 c.c., to be diluted one-half with freshly prepared saline solution, and the total amount used per case averages 250 c.c., though in severe cases, treated late, much larger amounts have been given. The succeeding injections, decided upon on the basis of the clinical evidences, are administered generally at intervals of 8 or 12 hours.

The best results from Type I serum have been obtained at the Rockefeller Institute, where the mortality in Type I cases was reported lowered to 6.5 per cent. Results obtained elsewhere have ranged from the same order of benefit to no apparent difference between treated and untreated cases. A serum for Type II has also been prepared, but the results from it have been somewhat less favorable.

Polyvalent serum seems to be useful mainly in Type I cases, doubtless because of the antibodies to this type it includes.

Reactions to serum injection may consist of either anaphylactic shock, preventable by taking the precautions above alluded to, and which is generally amenable to adrenalin and atropine, or of serum disease, developing 7 to 14 days after the injection, with fever, rash, joint pains and enlargement of glands, for which antipruritic lotions may be used and which passes off in a few to 10 days.

The writer employed a simultaneous intravenous injection of 0.5 mgm. ($\frac{1}{30}$ grain) of **adrenalin** with **antipneumococcus serum** in 44 cases, all of which recovered. This combined treatment brings on the crisis which ordinarily terminates the disease. Renaud (Bull. Soc. méd. des hôp. de Paris, June 17, 1921).

Report of a series of cases in which **antipneumococcus serum** was administered as soon as the diagnosis was made, without waiting for the sputum test. In addition, polyvalent serum was given in all cases of lobar consolidation, of whatever cause. Subcutaneous injections of 2, 3 and 5 c.c. of serum were made at intervals of 1 or 2 hours for the purpose of desensitization. About $\frac{1}{2}$ the cases had signs of serum sickness for 2 to 10 days. The mortality among the cases receiving serum was 13.9 per cent., as against 29.8 per cent. in untreated non-epidemic cases and 66.7 per cent. in untreated epidemic cases. Camac (Amer. Jour. Med. Sci., Oct., 1923).

Cole has shown that after injection of Type I or Type II serum, specific agglutinins can be demonstrated in the patient's blood, and has also emphasized the sterilizing power of Type I serum. Numerous patients with Type I septicemia showed sterile blood cultures after serum. The marked drop in death rate from Type I serum was doubtless due largely to this property. By early use of serum it is often possible in both Type I and Type II infections to establish a balance of protective substance in the patient's blood. Baldwin and Cecil (Jour. Amer. Med. Assoc., Nov. 20, 1926).

Differentiation of Types of Pneumococci.

—To determine which cases are specifically suitable for treatment by Type I or Type II serum, early "typing" is advised. This is usually done by the *mouse test*. A bean-sized portion of sputum from the deeper air passages, washed through 3 or 4 changes of salt solution, is ground up and emulsified in a sterile mortar with 1 c.c. of sterile bouillon or salt solution—added drop by drop—and

0.5 to 1 c.c. of the emulsion injected intraperitoneally in a white mouse. As soon as the mouse appears sick (5 to 24 hours), a drop of exudate is removed by peritoneal puncture with a sterile capillary pipette, and if an abundant growth of pneumococcus alone is found, the mouse is killed, the exudate washed out with salt solution and centrifugated, and a moderately heavy bacterial suspension thus obtained tested for agglutination with Type I, II and III serums.

In Tube 1 is placed 0.5 c.c. of Serum I (1:10); in Tube 2, 0.5 c.c. of Serum II (undiluted); in Tube 3, 0.5 c.c. of Serum II (1:10), and in Tube 4, 0.5 c.c. of Serum III (1:5). To each tube is added 0.5 c.c. of the bacterial suspension. After gentle shaking the tubes are incubated at 37° C. for 1 hour. Absence of agglutination indicates Type IV; agglutination in Tubes 2 and 3, typical Type II pneumococci; partial agglutination in Tube 2 but none in Tube 3, atypical Type II pneumococci; agglutination only in Tube 1, Type I pneumococci, and only in Tube 4, Type III.

Type determination may also be carried out from blood cultures, spinal fluid, empyema fluid, or material obtained by lung puncture.

Huntoon's Pneumococcus Antibody Solution.—This is an aqueous solution of immune bodies which have been removed from an antipneumococcus serum. Being practically free from the proteins of horse serum, it can be given without risk of producing anaphylaxis or serum sickness. It contains antibodies against Types I, II and III of pneumococcus, in amounts decreasing in the order given. It is most effective in Type I cases, yet contains sufficient Type II antibody to check Type II septicemia in monkeys when given early. In Huntoon's improved solution most of the chill-producing substances found in the original preparation have been eliminated. According to Baldwin and Cecil, 50 c.c. doses can usually be

given intravenously with slight if any reaction. Doses of 100 to 150 c.c., which are often needed, are still very apt to produce a chill. Aside from favorable effects in Type I and Type II cases, Cecil and Larsen obtained, with the older Huntoon preparation, a decided reduction of mortality in Type IV cases. This, however, has been ascribed to the foreign protein or shock reactions occurring with the older antibody solution; with the newer solution, results have not been striking in Type IV pneumonia.

Description of a rapid method for the determination of the type of pneumococcus. Sputum of satisfactory quality will coagulate if the test tube in which it has been poured is placed in boiling water for several minutes. The clot is broken up and the fluid separated from it added to the type sera. With positive sputa the readings are usually made in 15 or 20 minutes after receipt of specimen. About 3 c.c. of sputum is desirable for the test. Of 183 sputa received, 129 were satisfactory for this method of testing. In Type I cases, it was possible to send the serum back with the messenger who delivered the sputum, which resulted in the serum being administered within half an hour instead of the usual 24 hours. C. Krumwiede (N. Y. Med. Jour., Aug. 3, 1918).

Treatment of Complications and Atypical Forms.—**Cardiac Complications.**—In endocarditis, cold should be applied locally and absolute rest enjoined. If amelioration does not result, precordial counterirritation should be practised. In pericarditis, extensive serous effusion or purulent effusion in the pericardium requires paracentesis or pericardotomy.

Meningitis.—Where meningitis develops, lumbar puncture should be practised and antipneumococcus serum

administered. For further details, see the article on MENINGITIS.

Hiccough.—**Morphine** injected hypodermically may, in addition to inducing sleep, relieve the hiccough permanently. In some instances the administration of sugar upon which **compound tincture of cardamom** and **compound spirit of ether**, 10 drops of each, has been dropped, will suffice to arrest the symptom. In the more obstinate cases, **musk** may be given in doses of 1 grain (0.06 Gm.) in a capsule every three hours, in conjunction with **morphine** injections or **sodium bromide**.

Tympanites.—Milk should be discontinued, free **purgation** induced, hypodermic injections of **physostigmine** in doses of $\frac{1}{100}$ to $\frac{1}{50}$ grain (0.0006 to 0.0012 Gm.) or of **pituitary extract** administered, and measures taken to raise the blood-pressure, if low.

Acute Gastric Dilatation.—Where collapse, together with splashing in the stomach and excessive peristalsis, are noted as signs of this condition, **lavage of the stomach** through a tube should be at once performed and repeated thereafter according to indications. The patient should be placed on the right side. Hypodermic administration of **physostigmine** may be tried. No food or water should be given by the mouth; **rectal feeding** may be substituted.

Edema of the Lungs.—In this serious complication **cupping** and **venesection** are important measures. **Atropine**, with or without **morphine**, should be given hypodermically, the circulation stimulated, and **hot mustard foot-baths** administered.

Delayed Resolution.—When not due to empyema or tuberculosis, de-

layed resolution particularly demands attention to the general state of health and nutrition. The patient should have plenty of **fresh air**. Externally, **counterirritation** with **iodine**, **blisters**, or the **thermocautery** may be instituted; internally, **sodium** or **calcium iodide** should be given. **Fibrolysin** injections and, especially, the use of the **X-rays** have also been advised. **Deep breathing** appears sometimes useful.

Among 12 cases of unresolved pneumonia in babies and children treated by **X-ray** there was apparent benefit in 11. There seemingly was fever and constitutional reaction in 3 instances—temporary and probably beneficial. Three weeks of abnormal temperature and persistence of consolidation was arbitrarily taken as indicating unresolved lobar pneumonia. The 12 cases comprised 5 each of lobar and bronchopneumonia and 2 of an apparently combined type. The dose given was 5 ma., spark gap $7\frac{1}{2}$ in., distance 8 in., filtered through 5 mm. of aluminum and 4 of sole leather, the time being 5 minutes. The exposure was made posteriorly over the area of greatest consolidation. In only 2 cases was a second treatment required. G. N. Krost (Amer. Jour. Dis. of Childr., July, 1925).

For the treatment of complicating pleurisy, empyema, abscess, and gangrene of the lung the reader is referred to the articles: **PLEURA, DISEASES OF**, and **LUNG, DISEASES OF**.

According to Anders and Morgan, in serofibrinous pleuritis or empyema secondary to pneumonia, expectant treatment, unless **thoracentesis** be urgently needed, should be adopted until the crisis has been passed. If the latter fail to appear at the proper time, then the **exudate** should be **promptly withdrawn**. If crisis takes place in due season, a serofibrinous effusion is quickly absorbed in some cases at least; if not, recovery should be favored by **puncture followed by aspiration**. **Quinine** which is sometimes helpful, may be administered

in 4-grain (0.26 Gm.) doses in capsule, followed immediately by a few drops of dilute hydrochloric acid, four times daily.

Alcoholic Pneumonia.—In this type of case sufficient alcohol should be given to avoid the otherwise inevitable collapse. Manifestations of excessive nervous excitation should be subdued with the aid of such drugs as chloral hydrate, paraldehyde, morphine, and scopolamine.

Bilious Pneumonia.—Special care should be taken to activate elimination through the kidneys, intestine, and skin. Saline enteroclysis or hypodermoclysis and the administration of salicylates are indicated. Where malarial infection is known to exist quinine should be given.

Treatment During Convalescence.—During convalescence the administration of bitter tonics, iron, strychnine, quinine, phosphorus in cod-liver oil or the hypophosphites, arsenic, or calcium lactate, is frequently of advantage. Ample rest and a generous diet, deep breathing, massage, and at times temporary removal to a more favorable climate are also useful measures. Where a troublesome cough, with free expectoration, follows the pneumonia, such remedies as compound tincture of benzoin and terebene are appropriate and efficient. Sufficient time should be permitted, before allowing normal latitude in the patient's movements and conduct, for restoration of the lung-tissue and myocardium to their normal state. Fluoroscopic examination previous to final discharge of the patient is advisable.

C. E. DE M. SAJOUS

AND

L. T. DE M. SAJOUS,
Philadelphia.

PODOPHYLLUM.—*Podophyllum*, U. S. P. (mandrake, or May-apple), is the rhizome and roots of *Podophyllum peltatum* (family, Berberidaceæ), a plant (Umbrella plant or Duck's foot), indigenous to the United States and Canada. This plant yields 3½ to 5 per cent. of resin, a coloring principle—saponin—gum, starch, gallic acid, fixed oil, salts, etc. It contains no distinctive alkaloid; berberine, however, is present. The active principle, according to Podwissotsky, is a neutral crystalline body—picropodophyllin.

The official resin of podophyllum consists, in reality, of two resins: one is soluble in both ether and alcohol, the other only in alcohol. The former, present to the extent of 75 to 80 per cent., is the active part. It occurs as an amorphous brownish powder with a faint odor and slightly bitter taste. The resin is very irritating to the eyes.

PREPARATIONS AND DOSES.—

Podophyllum, U. S. P. (seldom used). Dose, 5 to 20 grains (0.3 to 1.20 Gm.).

Resina podophylli, U. S. P. (podophyllin). Dose, ⅙ to 1 grain (0.008 to 0.06 Gm.); official average dose, ⅙ grain (0.01 Gm.).

Pilulæ cathartice vegetabiles, N. F. (vegetable cathartic pills). For composition see under *COLOCYNTH*, Vol. III. Dose, 2 pills.

Pilulæ aloes et podophylli compositæ, N. F. (compound pills of aloes and podophyllum; Jancway's pills). For composition see under *ALOE*, Vol. I. Dose, 1 pill.

Pilulæ aloes, hydrargyri et podophylli, N. F. (pills of aloes, mercury and podophyllum; triplex pills). For composition see under *ALOE*, Vol. I. Dose, 1 pill.

POISONING BY PODOPHYLLUM.

—Podophyllum, or podophyllin, in large doses is a drastic cathartic; in toxic doses it causes violent gastroenteritis, with vomiting, excessive purging, violent abdominal pain, and collapse or convulsions.

Treatment.—The treatment consists in giving opium, stimulants, and demulcent drinks. Other indications will be afforded by the symptoms in the individual case.

THERAPEUTICS.—Podophyllum is a useful cathartic, acting most strongly where sufficient bile is present to solubilize the active resin. Habitual constipation which is due to impaired action of the muscular

coat of the bowel may be removed by the nightly use of a small dose of the resin, $\frac{1}{4}$ to $\frac{1}{2}$ grain, combined with the extract of belladonna, $\frac{1}{4}$ grain, and the extract of physostigma, $\frac{1}{4}$ grain (Bartholow). **Bleeding hemorrhoids** caused by stasis in the portal circulation, if of recent formation, may sometimes be cured by a full dose of podophyllum ($\frac{1}{2}$ to 1 grain). Podophyllum is useful in a variety of hepatic disorders: In **functional hepatic disturbances, portal congestion, and catarrhal jaundice**. The **digestive disturbances of malarial infection** may be relieved by a podophyllum purgation. **Sick-headache** associated with loose and dark-colored stools are amenable to podophyllum.

The smallness of the dose and slight taste of the resin make it serviceable in the treatment of **constipation in young children** or in **diarrhea due to diminished secretion**. When hard, stony stools occur in children one or two months old, a grain (0.06 Gm.) of the resin may be dissolved in a drachm of alcohol (or spirit of ginger) and two drops or more of this on sugar may be given once or twice a day. In the **summer diarrhea of children**, with watery passages having a musty or mousy odor, the resin may be given in doses of $\frac{1}{60}$ to $\frac{1}{30}$ grain (0.001 to 0.002 Gm.), repeated each few hours. In these small doses the resin will often stop **vomiting** if the liver is torpid and the stomach depressed. It is obvious that it should not be given if the vomiting is due to gastric irritation or inflammation. S.

POLIOENCEPHALITIS. See BULBAR PARALYSIS, AND MENINGES AND BRAIN, DISEASES OF.

POLIOMYELITIS. See SPINAL CORD, DISEASES OF.

POMEGRANATE. See PELLETIERINE.

POMPHOLYX (Dysidrosis; Cheiropompholyx).—Pompholyx is an acute exudative, contagious disease, characterized by the formation of deep-seated vesicles, which after a few days terminate by spontaneous rupture or absorption and are

followed by a slight desquamation of the epidermis. The eruption is symmetrical in its distribution, but is usually limited to the sides of the fingers and the palms of the hands. More rarely it appears on the soles of the feet and other portions of the body. At first, minute, isolated, transparent vesicles, deeply imbedded in the skin, they slowly increase in size, and become whitish or opaque, resembling rice-grains or sago beneath the epidermis. Resolution by absorption may now take place, but usually the exudation continues, the vesicles become larger and elevated above the surface, and may by coalescing form large bullæ. Absorption now causes the gradual disappearance of the vesicles, or rupture of the walls of the vesicles and bullæ ensues, with escape of their contents. The desquamation of the epidermis exposes a reddened, abraded, non-suppurating surface which rapidly heals. Slight itching and burning, with more or less nervous depression, accompany the eruption. Stiffness of the hands and fingers often result if the eruption is extensive. Pompholyx of the face may produce painful fissures.

DIAGNOSIS.—The presence of itching and burning distinguishes this from **sudamina**. Though some cases may resemble **eczema vesiculosum**, the subjective symptoms of the latter are more intense, the surrounding surface is hot and reddened, and the eruption of the vesicles results in the formation of crusts and leaves an exuding surface.

TREATMENT.—Full doses of **Fowler's solution** or **arsenic trioxide** exert a specific effect, and should be continued until all traces have disappeared. **Quinine, iron, strychnine**, and the **mineral acids** are useful, combined with a **nourishing diet**. Locally any **soothing ointment** will relieve the itching and burning and protect the abraded surface left after desquamation. W.

PONOS.—Ponos, or infantile kala-azar, is a subacute or chronic disease due to *Leishmania infantum* Nicolle. It clinically closely resembles Indian kala-azar, but occurs in childhood.

SYNONYMS.—Febrile splenic anemia (Fede), *Anamia infantum a Leishmania*

(Pianese), *Leishmania anemia* (Jemma and di Cristina), *Ponos* (Greece), *Malattia da mensa* (Sicily), *Marda tal biccia* (Malta).

SYMPTOMS.—The invasion is very slow and insidious, the first warning being some alimentary disturbance in the child, such as an attack of vomiting and diarrhea, with or without some enlargement of the spleen. As the child is anemic and has very irregular fever, the disease might be mistaken for malaria, especially as some attacks appear suddenly and are associated with rigors. Attacks of diarrhea alternating with constipation, attacks of irregular fever marked by apyrexial periods, and epistaxis appear and the child becomes pale and listless.

Somewhat later the spleen enlarges and protrudes from under the ribs. The febrile attacks become more marked, hemorrhages from the nose, gums, and under the skin occur, and the diarrhea or dysentery becomes more severe. Wasting and progressive anemia now appear, the face, conjunctiva, and the whole body assuming a peculiar white tinge.

The fever is very irregular; exacerbations may occur morning and evening, sometimes several times a day. High temperature may appear in cycles, or sudden falls to subnormal may be observed. The fever and pulse rate do not always go hand in hand; the latter is quite constantly rapid even during apyrexia, but may rise to 150 or 160 during the febrile period.

The blood shows a decrease in the erythrocytes ($1\frac{1}{2}$ to 3 millions) and in the hemoglobin (below 50 per cent.), and also in the leucocytes (1500 to 3000), which consist mostly of medium-sized cells. The mononuclears (70 to 80 per cent.) are increased at the expense of the polymorphonuclear cells, which furnish the remaining 20 or 30 per cent. Some poikilocytosis and anisocytosis are usually present, but nucleated cells are rare or absent.

Edema of the face, hands, feet, and genitalia may appear and disappear suddenly; it has a tendency to bilateral symmetry, but is influenced by the patient's position.

The liver usually becomes enlarged, but not to the extent of the spleen, the two combined causing enlargement of the ab-

domen and possibly some ascites. Although the urine is usually normal, there may be a diminution in the urea output, and at times slight albuminuria.

The child has a prematurely old appearance and the mental and physical powers become lessened. The bones, especially the ribs and scapulæ, become prominent, and death usually occurs from exhaustion induced by dysentery or diarrhea. Spontaneous recovery is rare.

DIAGNOSIS.—Ponos resembles *kala-azar*, sometimes very closely, but the former occurs in children and is inoculable into dogs, while the latter is seen mostly in young adults and is not inoculable into dogs. The temperature chart is, moreover, generally more irregular in ponos. The enlarged spleen, the irregular fever, and the pallor occurring in a child are the characteristic clinical symptoms. The parasite, however, is the positive factor in the diagnosis, and may be obtained by puncture from the spleen, liver and bone-marrow, or by vesication and examination of the fluid, and, if there are cerebral symptoms, by lumbar puncture. From *undulant fever* it is differentiated by the irregularity of the fever and an absence of the typical undulatory character; the spleen is more enlarged, the articular symptoms lacking, and Wright's agglutination test is negative. From *enteric fever* ponos is distinguished by the splenic enlargement, the irregular fever, and the absence of Widal's reaction. The absence of the plasmodium in the blood and the lack of influence of quinine on the fever would distinguish ponos from *malaria*. From *splénomédullary leukemia* it is distinguished by the leucopenia; from *syphilitic splenomegaly* by the history and the lack of effect from mercury and salvarsan; from *infantile afebrile splenomegaly*, in its various forms, by the fever and the parasite; from *rachitic splenomegaly* by the absence of bony deformities and by the presence of the parasite.

ETIOLOGY AND PATHOLOGY.—

Ponos is due to *Leishmania infantum* Nicolle, a parasite which occurs in dogs and may be transmitted to them and to monkeys from the human subject. The fleas of the dog are believed to transmit the disease to human beings.

The spleen and liver are much enlarged, the lymphoid tissue in the former being greatly increased. The islands of Langerhans in the pancreas are hypertrophied, and there is an overproduction of myeloid and lymphoid tissues in the bone-marrow.

PROGNOSIS.—This is very unfavorable, though spontaneous cure does occur.

TREATMENT.—Treatment is most unsatisfactory. **Atoxyl, salvarsan, mercury benzoate and bichloride, sodium arsenate,** and **iron cacodylate** with the **X-ray** have been used with little success. W.

POTASSIUM.—Potassium, or kalium, is a white metal, discovered by Sir Humphry Davy in 1807, having the consistence of wax; the fresh-cut surface has a silvery luster, rapidly changing by oxidation to bluish or gray. Its affinity for oxygen is very strong. Exposed to the air, it oxidizes instantly. Thrown upon water it takes fire spontaneously, and burns with a beautiful purple flame, yielding an alkaline solution of potassa, or potassium hydroxide. Potassium hydroxide, or potassa, is a strong, alkaline base, very deliquescent, and soluble in half its weight of water. From this base the medicinal preparations are made. The metal is never used in medicine. Some of the preparations are strongly alkaline and have a high diffusive power; this group contains potassium hydroxide, potassium carbonate and bicarbonate. A second series is neutral in reaction and alkaligenous (becomes alkaline by decomposition, the vegetable acid being replaced by carbonic acid, and an alkaline carbonate being formed); this group contains potassium acetate and citrate, of high diffusive power, and potassium and sodium tartrate and potassium tartrate, of low diffusive power. A third series is permanently neutral or acid; this

group contains potassium bitartrate and sulphate, of low diffusive power, and the nitrate, chlorate, dichromate, and iodide, of high diffusive power.

Upon a therapeutic basis, another useful classification may be made.

Caustics: potassa, potassa with lime (non-official), and potassium dichromate.

Purgatives: potassium bitartrate (4 to 8 drams—15 to 30 Gm.), potassium and sodium tartrate ($\frac{1}{2}$ to 1 ounce—15 to 30 Gm.), the acetate (2 to 4 drams—8 to 15 Gm.), and the sulphate ($\frac{1}{2}$ to 4 drams—2 to 15 Gm.).

Systemic antacids: the carbonate (10 to 30 grains—0.6 to 2 Gm.), the bicarbonate (20 to 60 grains—1.2 to 4 Gm.), the solution of the citrate (1 to 8 drams—4 to 30 c.c.), the acetate ($\frac{1}{4}$ to $1\frac{1}{2}$ drams—1 to 6 Gm.), and potassium and sodium tartrate (20 to 40 grains—1.3 to 2.6 Gm.).

Diuretics: the bitartrate (1 to 2 drams—4 to 8 Gm.), potassium and sodium tartrate ($\frac{1}{2}$ to 1 dram—2 to 4 Gm.), the acetate ($\frac{1}{4}$ to 1 dram—1 to 4 Gm.), the citrate $\frac{1}{4}$ to 1 dram—1 to 4 Gm.), the carbonates ($\frac{1}{8}$ to 1 dram—0.5 to 4 Gm.), the nitrate ($\frac{1}{6}$ to $\frac{1}{2}$ dram—0.6 to 2 Gm.), and the iodide ($\frac{1}{12}$ to 1 dram—0.33 to 4 Gm.).

Febrifuges: the solution of the citrate (1 to 8 drams—4 to 30 c.c.), the citrate (20 to 30 grains—1.3 to 2 Gm.), and the nitrate (10 to 30 grains—0.6 to 2 Gm.).

Alkaline solutions: solutions of the carbonate and the bicarbonate (1 to 2 drams—4 to 8 Gm.—to 1 pint—500 c.c.).

Antiemetic: the citrate of potassium ($\frac{1}{4}$ to 1 dram—1 to 4 Gm.).

PREPARATIONS AND DOSES.
—The official preparations of potassium are:—

Potassii hydroxidum, U. S. P. (potassium hydrate, or hydroxide; caustic potash; at least 85 per cent. KOH).

Liquor potassii hydroxidi, U. S. P. (solution of potassa, 5 per cent.). Dose, 10 to 30 minims (0.6 to 2 c.c.).

Potassii acetat, U. S. P. (potassium acetate). Dose, 10 to 60 grains (0.6 to 4 Gm.).

Potassii bicarbonas, U. S. P. (potassium bicarbonate). Dose, 10 to 60 grains (0.6 to 4 Gm.).

Potassii bitartras, U. S. P. (potassium bitartrate; potassium acid tartrate; cream of tartar). Dose, $\frac{1}{2}$ to 4 drams (2 to 15 Gm.).

Pulvis jalapæ compositus, U. S. P. (potassium bitartrate, 65 per cent.; jalap, 35 per cent.). Dose, $\frac{1}{4}$ to 1 dram (1 to 4 Gm.). (See JALAP.)

Potassii bromidum, U. S. P. (potassium bromide). Dose, 10 to 60 grains (0.6 to 4 Gm.). (See BROMINE.)

Potassii carbonas, U. S. P. (potassium carbonate; salt of tartar). Dose, 4 to 30 grains (0.25 to 2 Gm.).

Potassii chloras, U. S. P. (potassium chlorate). Dose, 4 to 10 grains (0.25 to 0.6 Gm.).

Potassii citras, U. S. P. (potassium citrate). Dose, 15 to 60 grains (1 to 4 Gm.).

Liquor potassii citratis, U. S. P. (solution of potassium citrate, 8 per cent.; "neutral mixture"). Dose, 1 to 8 drams (4 to 30 c.c.).

Potassii citras effervescens, U. S. P. (effervescent potassium citrate, containing 20 per cent. potassium citrate; granular salt). Dose, 1 to 3 drams (4 to 12 Gm.).

Potassii et sodii tartras, U. S. P. (potassium and sodium tartrate, Rochelle salt). Dose, 1 to 8 drams (4 to 30 Gm.).

Pulvis effervescens compositus, U. S. P. (Seidlitz powder: Sodium bicarbonate, 40 grains—2.5 Gm.—and Rochelle salt, 2 drams—7.5 Gm.—in blue paper; tartaric acid, 35 grains—2.2 Gm.—in white paper). Dose, 1 to 2 powders.

Potassii iodidum, U. S. P. (potassium iodide). Dose, 5 to 60 grains. (See IODINE.)

Liquor iodi compositus, U. S. P. (Lugol's solution: Potassium iodide, 10 per cent.; iodine, 5 per cent.). Dose, 3 minims (0.2 c.c.). (See IODINE.)

Potassii nitras, U. S. P. (potassium nitrate; saltpeter; sal prunella). Dose, 5 to 15 grains (0.3 to 1 Gm.).

Potassii permanganas, U. S. P. (potassium permanganate). Dose, $\frac{1}{2}$ to 3 grains (0.3 to 0.2 Gm.). (See MANGANESE.)

Potassa sulphurata, U. S. P. (sulphurated potassa; liver of sulphur). Potassium polysulphides and thiosulphate, the sulphides corresponding to 12.8 per cent. of sulphur.

Antimonii et potassii tartras, U. S. P. (tartar emetic). Dose, $\frac{1}{40}$ to $\frac{1}{2}$ grain (0.0015 to 0.03 Gm.). (See ANTIMONY.)

Syrupus scillæ compositus, U. S. P. (Coxe's hive syrup—tartar emetic, 0.2 per cent.). Dose, 30 minims (2 c.c.). (See ANTIMONY.)

Mistura glycyrrhizæ composita, U. S. P. (Brown mixture—tartar emetic, 0.024 per cent.). Dose, 1 dram (4 c.c.). (See ANTIMONY.)

Liquor potassii arsenitis, U. S. P. (Fowler's solution of arsenic, 1 per cent.). Dose, 3 to 10 minims (0.2 to 0.6 c.c.). (See ARSENIC.)

The following were formerly official:

Trochisci potassii chloratis, U. S. P. IX (potassium chlorate, $2\frac{1}{2}$ grains—0.15 Gm.). Dose, 1 to 5 troches.

Potassii cyanidum, U. S. P. VIII (potassium cyanide). Dose, $\frac{1}{8}$ to $\frac{1}{4}$ grain (0.008 to 0.015 Gm.). (See HYDROCYANIC ACID.)

Potassii dichromas, U. S. P. VIII (potassium dichromate). Dose, $\frac{1}{10}$ to 1 grain (0.006 to 0.06 Gm.). (See CHROMIUM.)

Potassii ferrocyanidum, U. S. P. VIII (potassium ferrocyanide; yellow prussiate of potash). Dose, $7\frac{1}{2}$ grains (0.5 Gm.).

The following are semi-official:

Potassii chloridum, N. F. (potassium chloride). Dose, 15 to 30 grains (1 to 2 Gm.).

Potassii sulphas, N. F. (potassium sulphate). Dose, $\frac{1}{4}$ to 4 drams (1 to 15 Gm.).

Potassii hypophosphis, N. F. (potassium hypophosphite). Dose, 3 to 30 grains (0.2 to 2 Gm.). (See PHOSPHOROUS ACID.)

Syrupus hypophosphitum, N. F. (syrup of the hypophosphites). Dose, $2\frac{1}{2}$ drams (10 c.c.). (See PHOSPHOROUS ACID.)

Syrupus hypophosphitum compositus, N. F. (compound syrup of the hypophosphites). Dose, 2 drams (8 c.c.). (See PHOSPHOROUS ACID.)

Unguentum potassii iodidi, N. F. (potassium iodide, 10 per cent.). (See IODINE.)

Tinctura antimonii, N. F. (tincture of antimony—tartar emetic, 0.4 per cent.). Dose, 15 minims (1 c.c.).

PHYSIOLOGICAL ACTION.—

Potassium exerts a depressant action on the heart-muscle, skeletal muscles, nerves, and nerve-endings. On the contrary, smooth muscle is stimulated by it. These effects are possessed in a varying degree by the different salts and are modified by the amount taken. They are, however, not produced when

ordinary doses are taken by the mouth, for the rapidity of the subsequent excretion precludes the accumulation of a toxic amount of potassium in the tissues. Thus, the only effects produced by such doses are of an osmotic character, *e.g.*, a diuretic action and minor changes in metabolism. The therapeutic effects of the potassium salts are largely, therefore, those of the acid ion with which the potassium is combined.

In its relationship to other metallic ions, potassium is found to be mutually antagonistic to sodium and calcium. The toxic effects of potassium chloride given intravenously are reduced by sodium chloride. Increase of the ratio of potassium to calcium ions to which the heart is exposed leads to effects resembling those of stimulation of the vagus nerve. On the other hand, deficiency of potassium as compared to calcium leads to strengthening of the heart-beats and eventually to arrest in systole.

In a case of tetany following on a severe gastrointestinal disturbance in a child of 2, the remarkable feature was that the tetany came on regularly when there was marked retention of water, and it subsided with this. The tetany was evidently due to substances retained in and with the water, and everything seemed to point to the potassium salts in the water as the substances to be incriminated. Potassium and sodium salts seem to have a direct spasm-producing influence, while calcium has the opposite effect. Lust (Münch. med. Woch., July 8, 1913).

The potassium salts with the vegetable acids (acetate, citrate, tartrate, etc.) are decomposed in the system; the alkaline base combines with carbonic acid, and when excreted by the kidneys alkalinizes the urine.

The salts with the mineral acids (nitrate, sulphate, etc.) are not so decomposed, but, in passing through the body in the blood-stream, act more or less deleteriously on the blood elements (protoplasm and cells) and upon the various organs (nervous, muscular, glandular, etc.).

The potassium salts are eliminated chiefly by the kidneys, though the salivary, mammary and sudoriparous glands lend their aid. Kramer has found the nitrate in the feces of animals taking this salt, and infers that a portion of the potassium salts passes through the bowels unchanged.

Potassium hydroxide (caustic potash, potassa) is an active caustic, abstracting water and fat from the tissues, dissolving the albuminous elements of the parts, and when applied to the skin it produces a soft eschar which, through inflammatory action, is sooner or later separated from the untouched parts. It is a corrosive mineral poison when taken internally in concentrated form, macerating and destroying the soft parts, and causing a secondary inflammation of the larynx and esophagus which often ends in stricture and gastritis. These symptoms may be produced by liquor potassii hydroxidi, unless very largely diluted when given.

Potassium carbonate is a strong antacid in the stomach and in the blood. It favors the excretion of uric acid and with it forms salts more soluble than the sodium salts. The bicarbonate is, however, preferable for internal use, being more acceptable to the stomach. It alkalinizes the urine when taken internally.

Potassium bicarbonate in small doses, taken before meals, stimulates the secretion of gastric juice and makes

the urine more acid. Larger doses impair digestion, are partly decomposed by the gastric juice, which is rendered less acid, and pass in part into the blood, increasing its alkalinity and likewise that of the urine. A vesicular eruption simulating that of eczema has been noticed as an exceptional effect of this salt.

Potassium chlorate differs from all the other salts of potassium, not only in its physiological action, but in its therapeutic effects. In small doses it is an alterative, stimulant and antiseptic. When locally applied to the mucous membranes its action is that of an irritant. It was formerly believed that potassium chlorate, when taken into the system, was decomposed and yielded up a large amount of its combined oxygen to the tissues. This was apparently proved to be erroneous by Prinz, who called attention to the fact that the salt is excreted unchanged, very largely by the salivary glands. W. E. Dixon ("Manual of Pharmacology," 3d ed., 1912), however, shows that chlorates undergo a slow reduction when in contact with putrefying organic matter, and are eliminated by the salivary glands, mucous membranes, and kidneys. He concludes that, although normal tissue fails to reduce them, the reduction is effected by septic tissue. The chlorate is, perhaps, the most poisonous salt of potassium, with the exception of the cyanide. When given in large doses it is absorbed into the blood, has a paralyzing effect on the spinal cord, and causes destructive changes (methemoglobinemia) and, if given in overdose, induces acute nephritis. One of the rare effects of the salt, when taken internally, is the production of an

erythematous, vesicular, or papular eruption. When the salt is given its effects should be closely watched. The appearance of drowsiness and scant or suppressed urine demands its immediate discontinuance. It should never be triturated with sulphur, tannin, charcoal, or glycerin, as an explosion is apt to follow.

Potassium ferrocyanide (yellow prussiate of potash) is not used as an internal medicine, except as a chemical antidote to poisoning by copper sulphate, but is used in the preparation of dilute hydrocyanic acid, cyanides, ferrocyanides and other salts. When pure, it may be taken in large amounts without producing physiological or other effects.

Potassium nitrate, given parenterally, slows the heart action and decreases the arterial tension. In large doses it exerts a paralyzing influence upon the spinal cord, and gives rise to marked muscular weakness and diminished reflexes. The movements of the heart are weakened and finally arrested. The fibrin of the blood becomes less coagulable and the oxygen-carrying power of the red blood-cells is diminished. The function of the kidneys is stimulated, as is shown by the increased quantity of urine excreted. Its irritant action on the gastrointestinal mucosa has produced death. Aubert and Dehn have shown that, with the exception of the permanganate, most of the potassium salts have the same effect on the circulation as the nitrate. Potassium nitrate is excreted unchanged.

Potassium sulphate is a powerful purgative, but is seldom used because of its irritant action.

Potassium and sodium tartrate (Rochelle salt) has the same purgative

action, but is more pleasant; in small doses it is an excellent laxative. It is an ingredient of the Seidlitz powder (*pulvis effervescens compositus*).

Potassium bitartrate (cream of tartar) is a diuretic as well as a laxative. It is an ingredient of the compound jalap powder (*pulvis jalapæ compositus*), a safe and efficient cathartic in cardiac and renal dropsy.

POISONING BY POTASSIUM AND ITS SALTS.—Potassium and its salts are rarely used for suicidal purposes. They are, however, extensively used in the arts, in the manufacture of glass and soap, under the name of potash and pearl-ash, and soap-lees, and in the form of concentrated lye for household purposes; sickness and occasionally death have occurred as the result of taking them accidentally.

POTASSIUM HYDROXIDE.—The symptoms of poisoning by potassium hydroxide or lye are an acrid, nauseating taste, followed by a burning heat in the throat and stomach, severe abdominal pains, vomiting and purging. Forty grains (1.3 Gm.) of caustic potash in solution have caused death. Death may take place within a few hours or days from laryngeal spasm or edema, shock, or cardiac paralysis, or it may be protracted several months (from inflammation of the stomach and intestines or stenotic disorders produced by cicatrization). (See ESOPHAGUS.)

The Treatment of Poisoning by Caustic Potash.—This consists in the evacuation of the stomach and administration of a vegetable acid,—acetic, citric, or tartaric,—in the form of vinegar, cider, or lemon-juice, which neutralizes the alkali and forms neutral salts. The fixed oils, which with

potash form soap, should be given. **Demulcent drinks** will soothe the congested alimentary canal; **digitalis** and **stimulants** (hypodermically) will sustain the heart, and **opium** will alleviate the pain, control the purging, and lessen the inflammatory symptoms.

POTASSIUM DICHROMATE.—

The dichromate of potash is an irritant corrosive poison. The symptoms of poisoning by this substance are yellow stains about the body and clothes, restlessness, violent abdominal pain, vomiting, purging, and collapse. Death occurs from cardiac paralysis.

The **treatment of poisoning by potassium dichromate** consists in the **evacuation of the stomach and bowels**, the administration of **chalk, soapsuds**, and **milk or albumin**, and the use of **demulcent drinks** and **opium**.

POTASSIUM BROMIDE.—This salt occasionally causes gastralgia when taken upon an empty stomach.

Treatment of Poisoning by Potassium Bromide.—This consists of the administration of **hot drinks** and **emetics**. (See BROMIDES.)

POTASSIUM CHLORATE.—In toxic doses potassium chlorate exerts a paralyzing effect upon the spinal cord, but has a more profound action upon the blood, disintegrating the corpuscles and making it of a chocolate color. In poisonous doses vomiting with hematemesis, delirium, hematogenous jaundice, and coma result.

The general body temperature is markedly depressed, and rigors, cyanosis, and great muscular weakness are usually present. Death occurs from the depression of the vital powers, due to its destructive action upon

the blood and the congestive obstruction of the kidneys.

In addition to the above symptoms the appearance of small, punctiform hemorrhagic spots on the legs and extending to the trunk and upper extremities has been observed as late as the sixteenth day.

Experiments showing that potassium chlorate is a strong poison for the nerve-cells, which are first excited, then paralyzed. On introducing it into the circulation it seems fair to assume that a certain amount reaches the brain in sufficient concentration to excite and paralyze, especially the respiratory center. S. J. Meltzer (Therap. Gaz., July 15, 1900).

Case of potassium chlorate poisoning after 6 Gm. (1½ drams) of this salt had been taken with suicidal intent. Hemolysis followed, with profuse hemorrhages from the digestive tract. Under **blood transfusion** conditions materially improved each time, but acute failure of the kidneys developed after the fourth transfusion in the course of a week, leading to a fatal issue. Zuccola (Policlinico, Jan. 17, 1921).

Treatment of Poisoning by Potassium Chlorate.—Two symptoms have been pointed out by F. Forchheimer as being a warning for the stoppage of this drug: drowsiness and a scantiness of suppression of the urine. Landerer advises, as the best treatment, **venesection** followed by **infusions of normal salt solution**, or, better, of **defibrinated blood**. In addition we may suggest, further, the use of **saline purgatives** and **diuretics**, especially **caffeine** and **calomel**, with **hot baths**.

POTASSIUM CYANIDE.—The **symptoms and treatment** of poisoning by this drug are those of hydrocyanic acid poisoning (see HYDROCYANIC ACID). The prompt administration

of **alkalies** is advised to prevent the decomposition of this salt by the gastric juice. The **stomach and intestinal canal** should be **evacuated** as soon as possible and arterial stimulants (**coffee, ammonia, caffeine**) administered. **Cold affusions to the spine and friction of the extremities** are indicated. Among the chemical antidotes, **hydrogen dioxide, potassium permanganate** in 1:400 to 1:200 solution, **sodium thiosulphate** in 1 per cent. solution, and the **arsenic antidote** (especially with further addition of **ferrous sulphate**) are those most favored. Death has occurred from 3 grains (0.2 Gm.) of this drug.

Acids should not be taken after the ingestion of potassium ferrocyanide, as it is decomposed even by weak acids, with the liberation of hydrocyanic acid.

POTASSIUM NITRATE.—In large doses this substance is an irritant poison. Death has occurred from 1 ounce (30 Gm.). The poisonous symptoms are intense abdominal pain, vomiting, coldness of the extremities, diminished body heat, partial paralysis, tremors, convulsions, and collapse. This drug has a paralyzing influence upon the spinal cord, which is evidenced by a great muscular weakness and diminished reflex sensibility. Death usually occurs from cardiac paralysis or from collapse due to the irritant action of the drug upon the gastrointestinal mucous membrane.

Treatment of Poisoning by Potassium Nitrate.—There is no chemical or physiological antidote. The treatment of poisoning should begin with the **evacuation of the stomach**. **Mucilaginous drinks** may be given, and **external warmth** applied to the body.

Cardiac stimulants (**amyl nitrite, caffeine, atropine**) are needed to sustain the heart.

POTASSIUM SULPHATE AND TARTRATES.—These salts in large doses act as irritant poisons, producing severe abdominal pain, vomiting, etc.

Treatment of Poisoning by Potassium Sulphate and Tartrates.—This consists in the **evacuation of the stomach** and the administration of **warm demulcent drinks and opium**. Cardiac stimulants may be needed, and **warm external applications** are usually indicated.

THERAPEUTICS.

CAUSTICS.—The caustic alkalies possess a very high diffusive power, and penetrate and destroy the tissues widely and deeply; so that certain precautions should be observed in their use lest the amount of tissue destroyed be larger than desired. When potassium hydroxide is used as a caustic, the surrounding parts should be protected by adhesive plaster in one or more layers, a central hole having been cut out through which the caustic may have access to the skin. The size of the hole should be rather less than the area to be acted upon, as the eschar is apt to be larger than the area to which the caustic has been applied. The caustic in the form of the fused potassium hydroxide is moistened slightly and rubbed firmly upon the surface until it assumes a dull-bluish look, and until the cuticle is softened and easily rubs off. The spot should then be washed with dilute vinegar, to neutralize any of the remaining alkali, and a poultice applied to facilitate the separation of the slough and to ease the pain.

Potassium hydroxide alone is often more powerful than is desired, and it is commonly combined with quicklime, in equal amounts, forming *potassacum calce* (U. S. P., 1890), or Vienna paste, which must be moistened with alcohol before use.

Potassium hydroxide and Vienna paste have been extensively used to destroy **cancerous growths**, to limit **sloughing ulcers**, to remove the thickened, indurated edges of **chronic ulcers**, and to open **boils**, **carbuncles**, and **indolent or deep-seated abscesses**. They are said to prevent scarring. They have also been employed in the treatment of **warts**, **nevi**, **malignant pustules**, and **phagedena**. Caustic potash has been used by surgeons in the postoperative treatment of **fistula in ano**, to keep the cut edges apart until the deeper parts of the wound are filled with granulations.

Ingrowing toe-nail may be treated successfully by painting the offending portion of the nail with a solution of potassium hydroxide (25 to 40 per cent.). In a few seconds the upper layer of the nail will become soft enough so that it can be easily scraped off with a piece of broken glass. This operation is repeated until only a thin scale of the nail remains, which may be excised with a pair of fine scissors.

Liquor potassii hydroxidi has been used externally in the treatment of **felons**. The undiluted solution, painted on the felon every hour or two in its early stages, in many cases will abort it. Poultices containing a considerable quantity of unleached wood-ashes is used in treating felons by the laity, with good results. In a diluted form, *liquor potassii hydroxidi* is used in cutaneous affections charac-

terized by acid secretions and to remove crusts, etc.

Potassium dichromate, another member of this group, is used in saturated solutions for the removal of **cancerous tumors**, **rodent ulcers**, **corns**, **warts**, **venereal vegetations**, and **mucous patches**.

The author has used potassium dichromate in the treatment of **cancer**. In 20 cases he injected about 8 to 15 minims (0.5 to 1 c.c.) of a 10 per cent. solution into the tumor every other day, and obtained excellent curative results. As many as 40 injections were made in some cases. Through this treatment gangrene was induced, the tumor shrunk progressively, and complete cure was finally obtained. Although in only a few of the cured cases was the diagnosis confirmed by the microscope, his results are worthy of notice. J. Fenwick (*Brit. Med. Jour.*, No. 2514, p. 589, 1909).

The author obtained a successful result in a case of **rodent ulcer**, from the external application of a 10 per cent. solution of potassium dichromate. W. M. Gemmill (*Brit. Med. Jour.*, No. 2547, p. 1225, 1909).

In a 1 per cent. solution it is an astringent and deodorizer. This salt is used in the preparation of the **battery fluid** used in zinc-and-carbon batteries, and is made as follows: 6 ounces (180 Gm.) of this salt are dissolved in 3 pints (1500 c.c.) of water and 6 fluidounces (180 c.c.) of commercial sulphuric acid are very slowly added to the solution. **Müller's fluid**, used for the preservation of anatomical and pathological specimens, is composed of 3 parts of potassium dichromate and 1 part of sodium sulphate dissolved in 100 parts of water.

SYSTEMIC ANTACIDS.—The members of this group are used to

neutralize an excess of acidity, acting locally, in the alimentary canal, or through the blood upon systemic disorders due to or aggravated by the presence of undue acidity.

In **acid dyspepsia** associated with **heartburn** and **pyrosis**, large doses of potassium bicarbonate (20 to 30 grains—1.3 to 2 Gm.) will be found useful. In **acid dyspepsia with pain** or **vertigo**, Robin advises the following: Potassium bitartrate, 3 drams (12 Gm.); sublimed sulphur, $1\frac{1}{4}$ drams (5 Gm.); precipitated chalk, $\frac{1}{2}$ dram (2 Gm.); Dover's powder, 15 grains (1 Gm.); mix and divide into ten powders, one to be taken after each meal. In **atonic dyspepsia** small doses of the bicarbonate will stimulate the secretion of the gastric juice. In some cases of **gastralgia**, potassium bicarbonate in full doses, given in some effervescent water, will afford prompt relief. The **indigestion of obese persons**, especially if they are **rheumatic** or **gouty**, will be relieved by full doses of the bicarbonate given after meals, in a full glass of water or, better, carbonic acid water. The bicarbonate will not only prevent the formation of butyric acid, but will, moreover, also assist in emulsionizing the fats and in their absorption. In **acid diarrhea** potassium bicarbonate is an efficient remedy.

In **bronchitis**, especially in **rheumatic** and **gouty persons**, liquor potassii hydroxidi is a good addition to the cough-mixture. J. V. Shoemaker gave the following: Liq. potassii hydroxidi, 1 dram (4 c.c.); syrup of senega, 1 ounce (30 c.c.); compound mixture of licorice, enough to make 6 ounces (180 c.c.). Of this a dessert-spoonful, in a wineglassful of water, is given every three hours when the ex-

pectoration is tough and scanty. In **pertussis**, potassium carbonate has been found valuable, given in doses of 1 to 2 grains (0.06 to 0.13 Gm.) several times a day.

In **gonorrhea**, as the urine is rendered alkaline under its use, liquor potassii hydroxidi is frequently combined with other remedies, as in the following: Liq. potassii hydroxidi, balsam of copaiba, of each, 6 drams (24 c.c.); mucilage of acacia, 3 ounces (90 c.c.); spirit of nitrous ether, 6 drams (24 c.c.); tincture of opium, 1 dram (4 c.c.); water, enough to make 6 ounces (180 c.c.). Of this a table-spoonful, well diluted, is given three or four times a day in **acute gonorrhea**. In **cystitis** and **pyelitis** the same combination will be found serviceable. If in cystitis alkaline decomposition has set in, the use of alkaline remedies will aggravate the disorder by aiding the transformation of urea into ammonium carbonate.

In **acute rheumatism in plethoric persons** with strong, acid perspiration, treatment with the alkalies gives most satisfactory results. If the system is alkalinized early in the disease, it is generally conceded that there is less danger of cardiac complications. The bicarbonate, citrate, acetate, or sal Rochelle may be given in doses of from 20 to 30 grains (1.3 to 2 Gm.) in cinnamon-water, well diluted, every three or four hours.

In **chronic rheumatism**, potassium iodide, in 10-grain (0.6 Gm.) doses, given in compound syrup of sarsaparilla three times daily, may be supplemented by alkaline baths made by dissolving 7 to 14 ounces (215 to 430 Gm.) of potassium bicarbonate in 30 gallons (120 liters) of hot water. The bath should be taken warm.

are needed, as they aid elimination and are antacid. A useful laxative where **hemorrhoids** are present is the following: Cream of tartar, 1 ounce (30 Gm.); washed sulphur, aromatic powder, of each, $\frac{1}{2}$ ounce (15 Gm.); one teaspoonful of this may be made into a bolus with orange-syrup, and taken once or twice a day. As an aperient, cream of tartar may be given in doses of from 1 to 2 drams (4 to 8 Gm.).

Sal Rochelle, or potassium and sodium tartrate, is an ideal saline laxative. It is most efficient when taken in the early morning when the stomach is empty, which is true of all salines. Sal Rochelle is the laxative agent in the Seidlitz powder, of which one is laxative and two are purgative.

The sulphate is a gentle cathartic, causing little pain, producing watery stools, and having some cholagogic action; it is said to act beneficially when **suppression of the milk** is desired, and is often given in **fevers** and **after delivery**, as a laxative, in doses of from 1 to 2 drams. Potassium acetate may be given as a purgative in doses of from $\frac{1}{2}$ to 2 ounces (15 to 60 Gm.).

FEBRIFUGES.—The members of this group are useful in **fevers** and **inflammations** in that they lessen heat and promote excretion of the inflammatory products. The febrifugal salts of potash lessen the blood-pressure, the temperature, and the heart's action.

In the **mild fevers**, as **measles** and **scarlet fever**, the solution of potassium citrate may be given in doses of 1 to 4 drams (4. to 15 Gm.) every two hours. If preferred, an extemporaneous solution may be prepared as

follows: Potassium carbonate, 15 grains (1 Gm.) is dissolved in $\frac{1}{2}$ ounce (15 c.c.—1 tablespoonful) of water, and this solution added to 1 ounce (30 c.c.—2 tablespoonfuls) of a mixture of equal parts of lemon-juice and water; this is given in a single dose, and should be freshly prepared each time. For convenience, a solution of the carbonate may be made up in quantity, each $\frac{1}{2}$ ounce (15 c.c.) of which contains 15 grains (1 Gm.) of the salt.

In **acute rheumatism**, potassium nitrate may be used as a febrifuge, 1 ounce (30 Gm.) of the salt being dissolved in 1 pint (500 c.c.) of barley-water or in the same quantity of syrup of gum arabic and water; a tablespoonful may be taken every three hours. In **pneumonia**, potassium nitrate may be given, with great benefit, in small doses ($\frac{1}{4}$ grain—0.015 Gm.), combined with $\frac{1}{12}$ to $\frac{1}{6}$ grain (0.005 to 0.01 Gm.) of Dover's powder every two or three hours. In **asthma** relief is generally obtained by igniting small squares of bibulous paper previously dipped in a 20 per cent. solution of potassium nitrate and dried (*charta potassii nitratis*, U. S. P., 1890), and inhaling the fumes. The **hoarseness of singers and speakers** is relieved by 2 grains (0.13 Gm.) of the nitrate dissolved in a glass of sweetened water. In **malarial intermittent fever**, the nitrate is especially valuable, if given in a single dose of from 15 to 25 grains (1 to 1.6 Gm.) in either the febrile or the non-febrile stage. The nitrate is a reliable remedy in **hemoptysis with fever**.

In **purpura simplex**, 10-grain (0.6 Gm.) doses of the nitrate are useful; in **purpura hemorrhagica** it may be given in doses of from 10 to 60 grains

(0.6 to 4 Gm.). In the treatment of **burns** of all kinds potassium nitrate has been strongly recommended by Poggi as a topical application. See **SKIN, INJURIES OF, and BURNS.**)

ALKALINE LOTIONS.—Alkaline lotions are used with benefit in cutaneous and other disorders. A weak solution of the bicarbonate (1 dram to 1 pint—4 Gm. to 500 c.c.) has been used as an application to **rheumatic joints**, and in **eczema** in the **early and middle stages** when there is a copious weeping from a red and raw surface. Hebra advises the application of the official liquor potassii hydroxidi or of a stronger solution, in the **chronic** forms of **eczema**. He brushes liquor potassii hydroxidi, once a day, over the surface, and, if it produces much smarting, washes the residue off with cold water. When the skin is only slightly infiltrated and thickened he employs a solution of 2 grains (0.13 Gm.) of caustic potash to 1 ounce (30 c.c.) of water; but, if the infiltration is greater, he uses a solution containing from 5 to 30 grains (0.3 to 2 Gm.) or more to the ounce (30 c.c.). These stronger applications must be employed only once a day and must be quickly washed off with cold water. This treatment speedily allays the itching, but is apt to make the skin brittle. To obviate this condition McCall Anderson applies, every night, either codliver oil or glycerin. Anderson frequently employs alkalies in conjunction with tar or oil of cade, as in the following: Equal parts of soft soap, rectified spirit, and oil of cade; a little of this to be firmly rubbed over the eruption night and morning; it should be washed off before each reapplication.

In **eczema of the vulva** Lusch ad-

vises the use of the following: Potassium bicarbonate, 1 dram (4 Gm.); sodium bicarbonate, 2 drams (8 Gm.); glycerin, 1½ drams (6 c.c.); laudanum, 2 drams (8 c.c.); water, 8 ounces (250 c.c.); this is to be used as a lotion, night and morning. In **pruritus vulvæ**, and in **bites and stings**, a solution of the bicarbonate (2 drams—8 Gm.—to 1 pint—500 c.c.—of water) will give relief. A weak solution of caustic potash or of the carbonate (1 dram—4 Gm.—to 1 pint—500 c.c.), applied with a small piece of sponge, is often of extreme comfort in **urticaria** or **lichen**. A solution of the same strength of the cyanide of potash, which has a strong alkaline reaction, is, perhaps, better. (Ringer.)

In **functional leucorrhea**, due to excessive secretion of the glands of the cervix uteri, the vaginal injection of a weak solution of the bicarbonate (1 dram—4 Gm.—to 1 pint—500 c.c.) will give relief; when the discharge is like the white of an egg or lumpy, three or four injections will often cure; but, when the discharge is yellow and puriform, these injections may fail, although in many cases, when this yellow discharge is due to a mere abrasion of the os uteri, these injections, continued for a week or two, will change the yellow to a white discharge. (Ringer.)

Potassium citrate is often serviceable as an antiemetic in doses of from ½ dram to 4 drams (2 to 15 Gm.); the official liquor potassii citratis is often preferred in doses of from 1 to 8 drams (4 to 30 c.c.).

In the **nausea and vomiting** of the first stage of **acute bronchitis** and of **febrile affections** in general, the use of the citrate in the form of "neutral mixture" (liquor potassii citratis) or

effervescent draught will allay the trouble. Effervescent draught is composed of two solutions: a solution of potassium bicarbonate, 154 grains (10 Gm.) in 2 ounces (60 c.c.) of water, and a solution of citric acid, 112 grains (7.5 Gm.) in 2 ounces (60 c.c.) of water, the dose being $\frac{1}{2}$ to 1 ounce of each solution, mixed when needed. This preparation should be freshly made, in small quantity, when wanted, as aqueous solutions of citric acid undergo decomposition.

POTASSIUM CHLORATE.—Potassium chlorate is different from all the other salts of potassium in its therapeutic effects.

Potassium chlorate in solution (1:16) is used as a detergent mouth-wash, and especially in **mercurial salivation**. The following solution is recommended for the latter use by Hare: Potassium chlorate, 48 grains (3.2 Gm.); tincture of myrrh, $\frac{1}{2}$ dram (2 c.c.); elixir of calisaya, 3 ounces (90 c.c.); of this mixture a teaspoonful may be taken every five hours, and may be used as a mouth-wash. In **membranous or ulcerative sore mouth, in children**, the same mixture or the plain solution (1:16) may be employed in smaller doses. In **aphthæ** the chlorate, finely powdered, alone or with powdered sugar, may be dusted on the patches. **Dillon's antiseptic dentifrice** contains potassium chlorate: Salol, chalk, charcoal, and powdered cinchona-bark, of each, $2\frac{1}{2}$ drams (10 Gm.); potassium chlorate, 1 ounce (30 Gm.).

In **diphtheritic and scarlatinal sore throat** the chlorate in solution (1:16) may be applied with a swab or used as a gargle, but it is not to be swallowed.

In **diphtheria** Waugh commends

the following: Potassium chlorate, 1 dram (4 Gm.); hydrochloric acid, $1\frac{1}{2}$ drams (6 c.c.); mix and add tincture of iron chloride, 2 drams (8 c.c.); water, a sufficient quantity to make 4 ounces (125 c.c.); of this a teaspoonful undiluted is given every two hours. When diluted with equal parts of water it makes an excellent gargle. Free chlorine is generated in this mixture.

In **anginose sore throat** H. C. Wood commended the following: Sumach berries, 1 ounce (30 Gm.); potassium chlorate, $\frac{1}{2}$ ounce (15 Gm.); boiling water, 1 pint (500 c.c.); allow to simmer for a few hours, then strain, cool, and use as a gargle several times during the day. The troches (U. S. P. IX) may be used, allowing the troche to dissolve slowly on the tongue, but not too freely, lest poisonous symptoms should develop.

Wohlgemuth says that potassium chlorate should not be administered on an empty stomach, and that the urine should be examined for met-hemoglobin, which should be a guide as to the dosage of the salt.

In **hay fever**, the chlorate has been found an efficient remedy.

The author has used potassium chlorate in the treatment of **hay fever (hyperesthetic rhinitis)** with results so satisfactory that he gives it first place. When the disease should appear the nose and throat are washed with a 3 per cent. solution, smoke and dust being avoided. When signs of irritation become manifest a menthol snuff is added; while for the attacks themselves he bathes the eyes with a 5 per cent. solution and insufflates the chlorate, finely powdered, into the nasal cavities; these applications are made morning and evening. W. Koster (Nederlandsch Tijdschr. v. Geneesk., No. 20, 1906).

In **inflammation of the bladder and rectum** this drug has been used in solution as an injection. In **acute rectal catarrh with mucous diarrhea and tenesmus**, H. C. Wood advises the use of a 4 per cent. solution of potassium chlorate by rectal injection; not more than 4 ounces (125 c.c.) of the solution should be used at one time, and that should be retained for twenty minutes. A cure will often result after one or two injections.

In some cases it is well to add a saturated solution of the chlorate to an equal quantity of starch-water, as the latter aids in allaying the irritation. This is also useful in **hemorrhoids**, especially if a few drops of laudanum are added.

The irritant action of the chlorate upon mucous membranes has been utilized in the treatment of **epithelioma** of the **eyelid**; daily applications of finely powdered chlorate to the tumors are suggested; in many cases the use of the knife was obviated.

In diseases of the cornea and conjunctiva the chlorate has proved efficient.

In diseases of the cornea and conjunctiva the author has found the chlorate generally useful. A case of **superficial marginal keratitis** was cured in a week by the use of a chlorate of potash lotion. In **corneal ulcer** it was used by dusting the powdered chlorate into the eye, for its antiseptic and astringent action. W. Koster (Nederlandsch Tijdschr. v. Geneesk., No. 20, 1906).

Dumontpallier used the chlorate in three cases of **tumors of the gums and of the tongue**. One patient had been operated on for **epithelioma of the tongue** and during convalescence a recurrent nodule appeared near the

cicatrix; applications of lunar caustic were made, but the nodule increased in size until in dimension and shape it resembled a large bean and was papillomatous in appearance. Local applications of the chlorate, in powder, were made six times daily, and $6\frac{2}{3}$ grains (0.4 Gm.) were given internally every four hours. In six weeks it was one-half the original size; three weeks later two small, painless protuberances were visible, and two months later the growth had entirely disappeared. Continuance of treatment for two or three months is advised, and absolute assurance of the functional activity of the kidneys is necessary. The condition of the teeth as a cause of irritation should be ascertained.

Potassium chlorate has been employed with more or less success in cutaneous disorders attended with suppuration. It has been found beneficial in the suppurative stage of **sycosis**, in **pustular acne**, in **eczema pustulosa**, and in the treatment of **furuncles** and **carbuncles**. Externally the chlorate has been found useful in powder or in saturated solution, as an application to unhealthy **ulcers**.

POTASSIUM CYANIDE.—Potassium cyanide has been used externally in solution (1 dram to 1 pint—4 Gm. to 500 c.c.) to allay **paresthesia**, and as an application to the head to relieve **reflex headache**.

It is used internally ($\frac{1}{16}$ to $\frac{1}{4}$ grain—0.004 to 0.015 Gm.) in mixtures to relieve **cough**, the effect being similar to that of hydrocyanic acid.

In **nervous dyspepsia**, J. P. C. Griffith combines potassium cyanide with extract of valerian, given after each meal.

NON-OFFICIAL POTASSIUM SALTS.—*Potassium Aurocyanide*.—

Potassium aurocyanide occurs in white crystals which are soluble in water. When injected hypodermically it is rapidly absorbed and does not precipitate albumin.

Behring's researches have shown that 1 part of this salt in 25,000 parts of blood-serum rendered the latter unsuitable as a medium for the growth of the **anthrax** bacillus.

Potassium Mercurocyanide.—The allied mercurocyanide effects the same in a dilution of 1:60,000.

Potassium-mercuric Iodide.—This double salt is formed by dissolving red mercuric iodide with twice its weight or more of potassium iodide in alcohol or water. It occurs as sulphur-yellow crystals, deliquescent in moist air, and soluble in water. Although used as an alkaloidal reagent, its medicinal uses are varied and important.

The formula of a 1 per cent. solution of mercuric iodide in potassium iodide as used by the author is: Mercuric iodide, 15 grains (1 Gm.); potassium iodide, 1 dram (4 Gm.); distilled water, $3\frac{1}{2}$ ounces (100 c.c.). This solution may be kept for months without change. The liquid is clear, of metallic taste, and irritating to the mucous membranes. If the local irritant effect is overcome by dilution, comparatively large amounts may be taken internally without producing severe symptoms. On a number of cases in which the drug was pushed, from 5 to 7 drops of a 1 per cent. solution was the limit of toleration, while from 15 to 18 drops of the same solution could be borne if well diluted.

Taken internally, the compound seems to have a marked effect on all catarrhal conditions of the mucous membranes, clearing up the common cold (**acute rhinitis**), ap-

parently shortening the course of **croup**, and modifying **acute infections of the nose, throat and bronchi**. This conclusion was reached after careful observation and repeated trial. Nearly all patients with catarrhal conditions remarked that it gave them great benefit in freeing the sticky mucus. This was particularly true in **acute bronchitis**. In cases of **gastritis** and **enteritis** exhibiting much mucus the same effect was noted. The drug further acts as a mild stomachic if used in a careful dose.

Locally a beneficial effect was often noted in **atrophic rhinitis**. In a number of cases of **acute frontal sinusitis** marked relief was noted because of the free rhinorrhea set up. The free outpouring of thin mucus sweeps before it the thick secretions that have accumulated in the blind cavities. In **syphilis**, **psoriasis**, **cryptogenic infections of the skin**, and **lupus**, the French have long been partial to potassium-mercuric iodide, using it both internally and as an ointment.

It is as an antiseptic, however, that the field for this compound is greatest, for in great dilutions its local effects and toxicity are insignificant, while its germicidal qualities remain high. A 1 per cent. solution has but slight irritant action, while a dilution of 1:80,000 or nearly one one-thousandth of 1 per cent. exhibits marked germicidal powers.

Cases of **erysipelas**, **acne**, **pustular infections of the skin** of all varieties show remarkable results under its use. The purulent discharge in minor surgical cases, such as **infected burns**, **old leg ulcers**, and **ragged wounds**, is rapidly cleared up. Even when the affection is somewhat subcutaneous, as in **felons** and **boils**, when there is as yet no pointing or definite formation of pus, a wet dressing of 1 per cent. potassium-mercuric iodide will usually reduce the case and frequently abort it altogether.

For the **sterilization of instruments** the drug is excellent, except for its tendency to tarnish if left in contact

too long. This can be easily overcome by the addition of a little sodium bicarbonate. Douglas Macfarlan (Jour. Amer. Med. Assoc., Jan. 3, 1914).

Potassium Cantharidate.—This substance occurs as a white, amorphous powder or in crystalline mass which is soluble in water. It has been used by Liebreich hypodermically in very attenuated solutions in the treatment of **tuberculosis**.

Potassium Cobaltonitrite.—This salt occurs in yellow, microscopic crystals, which are slightly soluble in cold water and insoluble in alcohol and ether. It is used where the nitrites are indicated (**dyspepsia**, **cardiac albuminuria**, etc.), and is claimed to be more easily regulated in its physiological action than most nitrites. It is given in doses of $\frac{1}{2}$ grain (0.03 Gm.) every two to four hours.

Potassium Dithiocarbonate.—This salt results from the action of carbon disulphide on potash-lye at boiling temperature. It occurs in an orange-red, deliquescent, crystalline powder, which is very soluble in water and slightly soluble in alcohol. It is used in a 5 to 10 per cent. ointment in the treatment of **eczema**, **tinea tonsurans**, and other cutaneous disorders. In a 20 per cent. ointment it is used in **psoriasis**.

Potassium Osmate.—Potassium osmate, or perosmate, occurs in a violet-red, crystalline powder, soluble in water. It is used in the dose of $\frac{1}{60}$ to $\frac{1}{4}$ grain (0.001 to 0.015 Gm.) in combination with the bromides against **epilepsy**, and hypodermically in **neuralgia**, **goiter**, etc., like perosmic acid.

Potassium Sozoiodolate.—Potassium sozoiodolate (or potassium diiodopara-

phenolsulphonate) occurs as a glittering, white, crystalline powder, having a slightly sour taste, soluble in hot water, and slightly soluble in cold water (1 to 70). It contains 52.8 per cent. iodine, 20 per cent. phenol, and 7 per cent. sulphur. It is antiseptic and bactericidal in its action. It is incompatible with mineral acids, ferric chloride, silver salts, etc. Strong sulphuric acid or heat drives off iodine vapor. It is a substitute for iodoform. It is non-toxic, odorless, and soluble. Even when applied pure it does not irritate the skin; when the skin is inflamed it leads to a mild and reactionless exfoliation. It acts as a desiccant in powder or salve in concentration of from 1:10 to pure.

It is used externally in **scabies**, **eczema**, **erysipelas**, **herpes tonsurans**, **impetigo**, **syphilitic ulcers**, **diphtheria**, **burns** and **scalds**, **ozena**, **otitis** and **rhinitis**, and as an injection in **gonorrhea**. A $2\frac{1}{2}$ per cent. solution is sufficiently strong to kill *Acarus scabiei* in twenty-five minutes.

Potassium Tellurate.—This salt occurs in white crystals, soluble in water. It was introduced by Neusser, and is used in doses of $\frac{1}{2}$ to $\frac{3}{4}$ grain (0.03 to 0.045 Gm.) in pill or alcoholic julep in the treatment of the **night-sweats of phthisis**. After one week it may be necessary to double the dose. No toxic symptoms follow its use. The appetite improves. During its administration the breath has a garlicky odor. This salt suppresses or diminishes the sweats, but does not influence the course of the disease.

C. SUMNER WITHERSTINE,
Philadelphia.

POTT'S DISEASE. See SPINE, DISEASES OF.

PRAIRIE ITCH.—Prairie itch is a name given to various skin affections, marked by pruritus, and seen among farmers, lumbermen, etc. It is probably due to a lack of cleanliness and the irritation of coarse underclothing.

TREATMENT.—Personal hygiene is of first importance in this disease. Warm cleansing baths should be taken at regular intervals. Woolen undergarments should not be worn, but if weather conditions make them necessary, a thin cotton gauze, silk, or linen garment should be worn next to the skin. Local measures give considerable relief, lotions being preferred when the itching is more or less generalized. Cider vinegar is a grateful application. Phenol, menthol and camphor, thymol, and witchhazel extract have been found useful. W.

PREGNANCY AND PARTURITION.

A. PREGNANCY.

DIAGNOSIS OF PREGNANCY.

—The vagina and cervix develop a succulent condition, with increased secretion, in the early weeks of pregnancy. There also often appears very early, especially in multiparæ, a slight bluish discoloration of the vaginal wall, which is most marked on the urethral prominence. The structure which is the very earliest to show the bluish discoloration, however, is the cervix; but the diagnostic value of discoloration at this point is reduced by the fact that it frequently appears also before menstruation. Later, in the third and fourth months of pregnancy, a very typical and rather pathognomonic dark blue color is visible at the introitus vaginæ.

Up to the twentieth week or during the first half of pregnancy, the diagnosis of the condition rests principally upon an enlarged uterus with a cessation of the menstrual flow. In

nearly all other conditions causing enlargement of the uterus there is either excessive loss of blood or, at least, no interruption of the menstrual cycle. In hematometra there is menstrual suppression but it is only apparent, the blood being retained within the uterus. In pyometra the menses are suppressed because the uterine surface from which the flow should come suffers from inflammatory destruction.

Certain minor signs of pregnancy which, while taken singly are not infallible, when all are present are strong presumptive evidence. These are: morning sickness, which is also characteristic of acute alcoholism; changes in the breast, not infrequently seen with uterine myomata, ovarian cysts, spurious pregnancy, and other rarer conditions, and both these signs may be absent though pregnancy exists; softening of the cervix may be the result of inflammation and the blue coloration of the vagina, while often not seen in pregnancy, is not infrequently observed with impacted pelvic tumors.

"Hegar's sign," consisting of the bimanual palpation of soft, edematous, anterior and posterior walls of the lower uterine segment, contrasting with the firmness of the fundus and cervix above and below, is not to be relied on alone, but combined with other symptoms is presumptive evidence.

The writer emphasizes a diagnostic sign for early pregnancy consisting of a circular area situated in the median line of the anterior surface of the body of the uterus, just above the junction of body and cervix. It varies in size according to the duration of pregnancy, and offers to the palpating finger the distinct sensa-

tion of elastic fluctuation. It can frequently be made out as early as the fifth week, when the area is only the size of a finger-tip; but it can always be felt in the sixth week, when it is somewhat larger. As pregnancy advances this area increases in size in a crescentic manner and extends upward toward the fundus until the third month of pregnancy, when nearly the entire anterior body of the uterus presents the phenomenon. L. J. Ladinski (Amer. Jour. of Obstet., Aug., 1913).

The writer considers it evidence of pregnancy if the palpating finger in the vagina meets the center of the cervix on the axial line of the canal. This shows that instead of the uterus being in normal ante flexion, it lies in a line with the axis of the vagina, with tendency to slide down into the latter. This indicates that the uterus is heavier than normal. The uterus is rendered heavy by the menstrual congestion preceding the onset of the menses, or else from the embedding of an ovum. If the menstrual discharge does not follow within a few days, the presumption of incipient pregnancy is justified. Dezwarte (Paris méd., Feb. 12, 1921).

"Quickening" as it depends upon the patient's statement is, in primiparæ, of little value, in multiparæ it is more significant; the uterine souffle indicates, at least, that the tumor is uterine, and is best heard over the broad ligament, but is present with a vascular myomatous uterus and exceptionally over a uterus drawn upward by a large ovarian cyst, and may be absent in case of pregnancy or present one day and absent another. While these minor signs are more or less confirmatory, the diagnosis cannot be settled by their presence or absence when the presence of an enlarged uterus with cessation of the menses is either ab-

sent or doubtful. Very often the thyroid gland is moderately enlarged in early pregnancy.

The ease with which uterine enlargement may be made out will depend upon the age of the pregnancy, the presence or absence of much fat in the abdominal walls, and the position and consistency of the uterus. After the first month an increased size of the uterus, if it can be made out, is pathognomonic of pregnancy. At three months it has ascended sufficiently to be palpated, except in very stout patients. The pregnant uterus in the early months is soft in consistency; percussion will reveal an area of dullness over the center of the lower abdomen. During the first month the uterus descends into the pelvis and the cervix is more easily reached.

The results obtained from the Abderhalden test in pregnancy have proven so unreliable that the procedure has been largely abandoned.

Alimentary glycosuria test for pregnancy commended. The first morning urine must first be tested and found negative to Fehling's test. No breakfast is taken. Granulated sugar, 7.5 Gm. for every 10 pounds of body weight (but not exceeding 150 Gm.), is given in 2 tumblers of water, each flavored with $\frac{1}{2}$ lemon. Voluntarily voided specimens of urine are collected 1, 2 and sometimes 3 hours after the dose has been taken. If either of the specimens shows a definite reduction of Fehling's solution, the test is considered positive. J. C. Hirst, 2d, and C. F. Long (Amer. Jour. Med. Sci., June, 1926).

At the beginning of the third month of pregnancy, and sometimes before, it is possible to obtain sufficiently satisfactory X-ray pictures of the fetus. In the later months, pregnancy can

be diagnosticated without difficulty. The diagnosis of multiple pregnancy can be made thus in the first half of pregnancy and abnormal positions, as well as probably hydrocephalus and certain malformations, made out. Extra-uterine pregnancies give as good pictures of the fetus as the normal, but the differential diagnosis depends chiefly on its asymmetrical position in the pelvis (Edling).

Chief among the factors complicating the X-ray diagnosis of pregnancy are the thickness of the maternal tissues, the relatively slight density of the fetal bones early in pregnancy, the blood in the uterine walls (which has been estimated to absorb 60 per cent. of the rays), the amniotic fluid, the respiratory movements of the mother, the movements of the fetus, and the unequal distances of different parts of the maternal pelvis and the fetus from the plate.

The technique used in the author's cases consisted of an exposure of from 4 to 6 seconds with a 5-in. spark gap and the use of 25 milliamperes, a diaphragm, and a cone. Most patients were placed in the prone position, and in every instance the central ray was directed parallel with the pelvic axis. During the third and fourth months no positive roentgenograms were obtained; during the fifth month, positive results were obtained in one-third of the cases; and during the sixth month in one-half of the cases. The earliest positive result was obtained at the end of 4½ months. From these results it would seem apparent that the roentgen ray may be of value in the diagnosis of pregnancy at practically the same stage that the other three positive evidences are obtainable: viz., (1) the fetal heart sounds, (2) palpation of the fetus, and (3) the fetal movements. However, in the second trimester of pregnancy its diagnostic value is limited by the fact that a

negative result does not necessarily mean that the patient is not pregnant.

A positive diagnosis may be obtained very exceptionally toward the last of the fourth month. During the seventh, eighth, and ninth months a positive diagnosis should be obtained in the great majority of cases. Bartholomew, Sale and Calloway (Jour. Amer. Med. Assoc., Apr. 2, 1921).

During the last half of pregnancy, from the fifth lunar month to the termination, the diagnosis rests upon the signs showing the presence of a fetus—the detection of fetal parts and movements, the fetal heart sounds, and the funic souffle. Besides, we have as additional signs the rhythmic contractions of the uterus and the shortening of the cervix which takes place during the last few weeks of pregnancy.

By abdominal palpation the fundus can usually be felt above the symphysis, and by the sixth month the position of the fetus may be outlined.

At seven months fetal movements can be detected and the fetal heart sounds heard; these are the basis of positive diagnosis; prior to this the diagnosis can only be probable. In exceptional cases the fetal heart sounds may be heard as early as the end of the fourth month, usually not earlier than the end of the fifth. Fetal movements are of two kinds, a sharp knock or rebound and a slower vermicular movement. The latter might be confounded with *intestinal peristalsis*; the former can be heard with a stethoscope.

A large *ovarian cyst* may be confounded with pregnancy in the later months, but there is an absence of fetal signs and the uterus of normal size may often be detected apart

from the swelling; if the latter cannot be made out, dependence must be placed on the menstrual history and the absence of fetal signs. From *ascites* pregnancy is usually differentiated, for the areas of dullness usually differ, except when the fluid is encysted and the dullness in the flanks and resonance in front may be absent. *Obesity* and flatulent distention attended by amenorrhea may be confounded with pregnancy; the aortic impulse transmitted through the uterus would aid in the differentiation. *Myomata* of sufficient size to be confounded with late pregnancy are never accompanied by amenorrhea.

ETIOLOGY OF DISTURBANCES DURING PREGNANCY.—

These may be inherent in the woman at the inception of pregnancy; they may be due to pregnancy, or they may be the result of pregnancy *plus* other causes to which the woman may have contributed or which may be regarded in the light of accidents.

The following able classification and the definition of each condition, by A. F. Currier, are submitted:—

I. Causes which are present when pregnancy is instituted.

1. Faults of structure.

(a) Structurally defective pelvis.

(b) Defective uterus.

(c) Tumors in various parts of the body, especially in the pelvis or abdomen.

2. Faults of nutrition.

(a) Badly nourished uterus.

(b) Local disease in any organ, or any disease which seriously modifies the general condition.

II. Causes which are due to pregnancy, the patient being apparently in normal condition at its inception.

1. Mechanical influences.

(a) Pressure of the enlarged or displaced uterus upon contiguous structures.

(b) Disturbed circulation either from immediate pressure upon vascular structures or arrests of the current in its ordinary channel.

(c) Pressure upon the uterus by a new growth which has developed coincidentally with pregnancy.

2. Nervous reflexes, usually irritative in character.

3. Nutritive changes especially in the blood, nervous system, digestive apparatus, or secretions.

III. Causes which are due to pregnancy *plus* additional provocation from within or without the individual.

1. Improper diet or habits.

2. Trauma.

3. Nervous and mental irritants.

4. Intercurrent disease.

5. Irritating conditions within the ovum.

I. **Causes which are Present when Pregnancy is Instituted.**—Of the causes of disorder in pregnancy which are present at the inception of the pregnant state there are, as before stated:—

1. **FAULTS OF STRUCTURE.**—(a) Structurally defective pelvis. This may consist in the various deformities—pelvis too large, pelvis too small, or pelvis of irregular contour—which interfere with the proper and symmetrical development and enlargement of the uterus and the ovum which it contains.

This interference in the development of the uterus may lead to abortion; may produce pain, nausea, and vomiting; faults of digestion, constipation, interference with the pelvic

circulation, and a variety of distressing phenomena during pregnancy, as well as difficulty during parturition. The pelvis may also be the seat of serious disease (*e.g.*, osteomalacia), weakening its structure and rendering it unfit as a support for the body and incidentally for the pregnant uterus.

(*b*) Defective uterus. This may consist in a faulty position or in imperfections of structure which may properly be attributed to bad nutrition. The displaced uterus—whether the displacement be anterior, lateral, or posterior—is certainly a defective uterus for any purpose and in any situation, and it becomes the more strikingly so when it has been impregnated. Normal development is hindered, the circulation becomes impaired, pain and discomfort give annoyance, and unless the displacement is corrected uterine contractions may be provoked and the contents of the uterus expelled. Correction may be and often is spontaneous, but is not always a result, especially if the displacement is a posterior one. The diagnosis is almost always susceptible of determination by means of a careful bimanual examination, and successful treatment is usually possible unless the uterus is fixed by adhesions in its faulty position.

(*c*) Tumors in various parts of the body, especially in the pelvis or abdomen. A tumor in any part of the body, especially if of a malignant character, may so impair the general condition as to militate against the successful continuance of pregnancy. This is notably the case, in addition to malignant disease, with the tumors which develop in connection with tuberculosis, syphilis, and other con-

stitutional diseases. With the tumors of the pelvis and abdomen, whatever their character, it is easy to see that, by their very presence, by their encroachment upon the space required by the uterus as it enlarges, they may be an efficient cause of pain, of disturbance in the circulation, of digestive disorders, etc., and if they do not compel the uterus to throw off its contents they may so complicate the situation that parturition will become not only difficult but positively dangerous. Indeed, successful delivery by the ordinary method and measures may be quite impossible, and removal of the tumor may be required before the uterine contents can be removed.

2. FAULTS OF NUTRITION.—(*a*) Badly nourished uterus. The uterus which thus becomes a source of disturbance during pregnancy may be congenitally defective, or its defects may be the result of disease, bad habits, or traumatism. The entire organ may be rudimentary and poorly developed, or the difficulty may be limited to the muscular structure or to the endometrium. Arrest of development during fetal life from causes which are not always traceable is not particularly rare. Arrest of development from the diseases common to childhood or from constitutional disease (syphilis, tuberculosis, etc.) is also not infrequent. Traumatism, as from rape, from the forcible thrusting of sticks or other hard substances into the vagina, from burns, and from caustic substance is of less frequent occurrence.

In any of these cases pregnancy comes to an organ badly prepared to perform its function, and it does not respond to the demands which are

made upon it. We should not be surprised that pain and discomfort accompany such a pregnancy, and that its termination should be an abortion in the early months.

Another class of cases is that in which the uterus is defective from growths within its structure, especially fibroid growths. Whether these are located within the muscular structure, upon the peritoneum, or within the uterine canal, they are always a menace to pregnancy, and frequently are an efficient cause in producing its premature termination. While the disorders which attend this class of cases consist principally in disturbance which affects chiefly the uterus itself and its immediate surroundings, it not infrequently happens that systemic infection is added, and the final result may be a disastrous one for the patient.

(b) Local disease in any organ, or any disease which seriously modifies the general condition. Aside from disease in the uterus itself antedating pregnancy, there may be disease in the tubes or ovaries or both which may give rise to much trouble. Simple inflammatory conditions of these organs or distinctly infectious disease, acute or subacute, may excite much discomfort and perhaps lead to serious results.

Disease of the liver, kidneys, heart, or lungs may antedate pregnancy and may suffer exacerbation as pregnancy advances.

Valvular *heart lesions* in the pregnant state are considered by Guerard to constitute a serious complication, he having observed a mortality of 28 per cent. The mortality has been even higher as reported by some other authors. Williams, however, considers

that these figures give an exaggerated idea of the seriousness of the condition, since they apply only to those cases in which compensation has long since failed and renal changes and toxemias exist. Jaschke, conversely, reports a mortality of only 0.39 per cent. among 1225 cases, and considers the danger overestimated.

Apparently functional murmurs are frequently heard in pregnancy, while serious organic lesions are only occasionally observed. Cases of broken compensation may result in such urgent symptoms as to demand induction of abortion or premature labor.

The most important cause of strain on the heart is the increased volume of the blood in pregnancy. With a weak heart this increased filling of the organ is not met by sufficiently stronger contractions, dilatation and its consequences resulting. In 40 per cent. of normal pregnant women tachycardia was noted. W. Frey (Klin. Woch., Mar. 26, 1925).

The presence of mitral stenosis was considered by Luck to be sufficiently serious to warrant the termination of the pregnancy as soon as diagnosis is made. A large number of cases observed by French and Hicks, however, have led them to conclude that it is no more serious than other lesions.

Generally speaking, the prognosis is good as long as compensation is retained. Grave heart lesions complicating pregnancy, however, predispose to premature labor, and collapse may manifest itself immediately after expulsion of the child.

Myocarditis and endocarditis must also be considered as serious complications of pregnancy, the former frequently giving rise to sudden death.

Hematuria is rarely observed dur-

ing pregnancy, but if blood should appear in the urine more or less serious lesions of the urinary tract should be suspected.

Pyelitis may appear in the latter half of pregnancy in patients who, having previously been perfectly well, or complained of slight vesical irritation, are suddenly seized with intense paroxysmal pains, usually in the right renal region, with high temperature and occasionally chills. Palpation shows an enlarged kidney. After a certain time a large amount of purulent urine is suddenly passed, the kidney becomes smaller, and the pain disappears. The symptoms reappear, however, as the kidney fills again. Unless treatment is carried out, septic infection may take place and terminate fatally. The diagnosis is usually clear, but yet may be mistaken for appendicitis, typhoid fever, or salpingitis.

In the attenuated form of pyelonephritis, slight albuminuria is the only symptom. It calls for relative rest, dieting and castor oil. The febrile form usually subsides in a week or 2 and the renal pain disappears under copious drinking, purgatives, and urinary antiseptics. When the fever persists, indicating retention, if the kidney is not enlarged, the writer injects into the bladder a tepid solution of boric acid, to be retained as long as possible, repeating this 3 times a day. This sometimes rouses the ureters to contract and evacuate the purulent urine. If not, one should not wait too long before catheterizing the ureter. If this is not practicable, evacuation of the uterus may restore normal conditions. Otherwise, one should operate on the kidney. Couvelaire (*Médecine*, Apr., 1920).

In pyelitis drainage is the most important factor, but the method to be used varies. In some the giving of

large amounts of methenamine water is sufficient to overcome the obstruction, particularly if a posture is found which will relieve the latter. Many cases respond to pelvic lavage with drainage by means of a pelvic catheter. In some cases one is faced with the necessity of a nephrostomy, induced abortion or premature labor. G. Baughman (*Amer. Jour. Obstet. and Gynec.*, Feb., 1921).

In the pyelitis of pregnancy, the writer is impressed with the results of permanent catheterization of the ureter. A large catheter must be used, 9 to 11 French, and left *in situ* 24 to 36 hours. If it becomes plugged, irrigation will restore the flow. It may be reinserted at intervals for weeks until cure results. Copious water drinking, proctoclysis and hypodermoclysis are very valuable, but should be pushed to the limit—up to 6 to 9 quarts in 24 hours—only during drainage of the kidney. Alternations of reaction of the urine are very useful. When alkaline, making it acid may take several days; when it becomes strongly acid, the converse modification is begun at once, and again takes several days. During acidity, the urinary antiseptics are given. R. C. Bryan (*Va. Med. Mthly.*, Aug., 1924).

Nephritic toxemia may be observed in women in whom chronic nephritis existed prior to pregnancy, or where an acute process originates during that period. It occurs only infrequently, but should be feared in women suffering from chronic nephritis. It may appear at any period of pregnancy, but more generally in the later months. The symptoms usually present are: lassitude, general malaise, headache, and marked edema; sometimes ocular disturbances with albuminuric retinitis may be observed. In other cases, edema may be the only symptom evident, with the exception of the urinary changes, and the patient may suddenly become

comatose, with accompanying convulsions and either die or slowly recover. With the exception of syphilis, Williams considers chronic nephritis the most common cause of spontaneous premature labor.

The prognosis is good so far as the immediate life of the mother is concerned, but, ultimately, the strain of pregnancy usually aggravates the original nephritis process.

The disorder may be sufficient to provoke abortion, or the patient may go to term. Death during parturition is not uncommon.

A typical pregnancy glomerular nephrosis is not likely to develop into chronic nephritis, yet an acute exacerbation of a previously existing glomerular nephritis during pregnancy may become chronic. In ordinary cases of pregnancy glomerular nephrosis, so long as there is no tendency to eclampsia interruption of the pregnancy is rarely indicated, but with acute and chronic glomerular nephritis, such interruption must always be considered. In acute glomerular nephritis, if the blood content of the urine increases in spite of treatment or if it remains high, interruption of pregnancy is imperative. T. Heynemann (Zentralbl. f. Gynäk., May 1, 1920).

General disorders at the inception of pregnancy may also prove very troublesome,—syphilis, tuberculosis, profound anemia, or any wasting or intensely infectious disease which in itself initiates profound asthenia. Pregnancy is often interrupted under such conditions. If it should continue to term the child may be dead at birth or so poorly nourished that death may occur without a very prolonged struggle.

While the occurrence of pregnancy in the *tuberculous* exerts a harmful in-

fluence on the progress of the disease, the latter, however, does not predispose to its premature interruption and in some cases birth has been given to large and well-developed children.

The influence of *syphilis* upon pregnancy differs considerably according to whether infection takes place before pregnancy, at the time of conception, or during pregnancy. In the former case abortion or premature labor usually takes place. In premature labor the child is generally born dead; less frequently it may be born alive with definite manifestations of the disease. The child is always syphilitic when infection has taken place at the time of conception. Its effect upon the fetus varies, however, when syphilis is contracted during pregnancy, signs of the disease being evident when infection occurs during the early months, while the fetus may escape infection if it occurs later.

Resuming the description of process as given by Currier:—

II. Causes which are Due to the Existence of Pregnancy, the Patient being Apparently in Normal Condition at its Inception.

1. MECHANICAL INFLUENCES.—

These are among the most common of the causes which disturb pregnancy. They are usually traceable without great difficulty, and in some cases are susceptible of removal. In the greater number of cases, however, they persist as long as pregnancy persists.

(a) Pressure of the enlarged or displaced uterus upon contiguous structures. The conditions relating to the displaced uterus have been described. It is not until after the first half of pregnancy, as a rule, that the pres-

sure of the uterus causes disturbance. One of the most common results of such pressure is disorder in the urinary function. Without discussing the various theories concerning the albuminuria of pregnancy, it is quite evident that pressure is one of the causes, for the albuminuria usually ceases when pregnancy is terminated. When one realizes the susceptibility of the kidneys to floating and wandering, it is not strange that they should occasionally get in the way of the enlarging uterus, even when it is progressing in a perfectly normal manner.

Pressure of the enlarged uterus is also responsible for various other disorders. Pressure upon the intestines may cause obstruction in those viscera, and it often happens that the constipation which may be so troublesome during pregnancy is traceable to such a cause, especially when the pressure is directed upon the rectum.

Pressure upon the stomach may cause more or less of the indigestion and gastric discomfort of the later months of pregnancy.

Pressure upon the liver, the gall-bladder, or the bile-ducts may account for jaundice, for nausea, and vomiting. Pressure upon the diaphragm causes some of the discomfort of the latter part of pregnancy, the difficulty in respiration, and sometimes the irregularity of action which is manifested by the heart.

Pressure upon the bladder gives rise to much discomfort in not a few cases. The uterus may so rest upon this viscus that it cannot distend symmetrically as the urine enters it. This may cause such a condition of irritability that there will be a con-

stant desire to micturate. Inability to empty the bladder completely often leads to decomposition of the residual urine, with resulting cystitis, which may persist long after pregnancy has ended. Disorders of the bladder are among the most annoying troubles from which pregnant women suffer. The results of the pressure of the enlarged uterus upon nerves and ganglia are not often sufficiently pronounced to excite attention. It is, of course, possible that the sacral nerves and the ganglia of the pelvis may be so encroached upon as to cause numbness or even paralysis of the lower extremities, on the one hand, and interference with the nutrition of the pelvic and abdominal viscera, on the other. The former condition has been observed by most obstetricians of experience in more or fewer cases.

(b) Disturbed circulation, either from immediate pressure upon vascular structures or arrest of the current in its ordinary channel.

The two primary conditions which may result from this factor are anemia and congestion. Anemia is experienced, of course, in the tissues which are immediately compressed. Such a result is usually transient, since the uterus does not normally exert its pressure over the same area for a long time. It must change its position and the direction of pressure as it enlarges and emerges from the narrow limits of the pelvis to the less restricted abdomen. If, however, it becomes agglutinated to any of the structures with which it is brought in contact, that structure may suffer, not only with anemia, but with the more serious effects of malnutrition which follow as a conse-

quence. Anemia of the compressed portion is not, of necessity, attended with congestion of the contiguous portions, for the anastomosing circulation may be so perfect that the blood-current will adapt itself to the new and changed conditions. Such a fortunate result does not always occur; hence the frequent manifestation of congestions in various parts of the body in response to the obstruction which has been placed in the customary channel for the blood.

The veins of the vulva and legs furnish the most vivid illustrations of these obstructive conditions. They are frequently enlarged to an enormous size, and their rupture, especially those of the vulva, during parturition may be attended with the most serious consequences.

(c) **Pressure** upon the uterus by a new growth which has developed coincidently with pregnancy. This complication is, of course, an unusual one. Pregnancy may incite abnormal activity in growths which were previously quiescent or not troublesome, or the first intimation of their presence may come with the obstruction which they cause during pregnancy. Ovarian cysts and fibroid tumors of the uterus furnish familiar examples of this form of obstruction. Less frequently seen are bony tumors of the pelvis, malignant growths of the pelvis and abdomen, and ascites, with tuberculosis and with disease of the liver, spleen, and kidneys.

2. **NERVOUS REFLEXES.**—It would be difficult to refer to all the possible disorders of this character. The nerve-connections of the uterus with other parts of the body, especially with the abdominal viscera, are so numerous that there is a certain de-

gree of reasonableness in attributing a great variety of nervous disturbances to a cause within the uterus. A woman with highly developed nervous system may be peculiarly sensitive to irritation when the uterus is in an exalted state of functional activity, and thus we may explain many of the peculiar phenomena of pregnancy. Perhaps the most common of these phenomena are the nausea and vomiting; the "morning sickness" of pregnancy. Others which are less noteworthy are neuralgias in various parts of the body, peculiar conditions of the special senses, disturbances of digestion, secretion, etc. The nexus between these conditions and pregnancy seems to be demonstrated in the fact that with the termination of pregnancy the conditions in question disappear also.

3. **NUTRITIVE CHANGES,** especially in the blood, nervous system, digestive apparatus, and secretions. Pregnancy is certainly the expression of a physiological requirement in animal nature. Normally it should be attended by no unusual phenomena; but unfortunately the absolutely normal type of pregnancy is seldom seen. The variations in connection with the nutritive functions are especially pronounced. In a general way it may be said that exaltation is the characteristic in one class of cases, and depression in another.

With the former the improved condition of the tissues shows the comparative gain in volume and nutritive value of the blood; the mind and nervous system, which may have been in a condition of irritation, are now so calm and equable that the change becomes noteworthy to those

who are familiar with the state of affairs prior to impregnation. The digestion is improved, the secretions by their abundance show the activity of the entire glandular apparatus; in a word, pregnancy has acted as a stimulant and tonic, and such women frequently declare that they have never felt better in their lives than when pregnant. This is the exaltation which may be coincident with pregnancy. In the other class the very opposite is seen: anemia becomes more and more marked as pregnancy advances, nervous and mental irritability and depression are more or less constant, melancholia and mania being not infrequent: digestion is constantly disturbed, nothing seems to be well assimilated, nausea and vomiting cause great annoyance, and the secretions are deficient in quantity and impaired in effectiveness. This is the depression which may also be the accompaniment of pregnancy.

III. Causes which are due to Pregnancy plus Additional Provocation from within or without the Individual.

1. IMPROPER DIET OR HABITS.—There are few subjects about which even intelligent people err more grievously than as to their diet and their ordinary habits. The selection of suitable food is at all times a subject of the first importance, and when those who suffer with the ills of pregnancy suffer also from the use of improper food, whether this be the result of necessity, or of ignorance, or of willfulness, the consequences are pitiable, for nature is no respecter of persons. The sufferings in these cases are primarily, of course, related to the digestive apparatus, indiges-

tion, constipation, nausea and vomiting, and loss of appetite being most conspicuous; but other portions of the economy may become involved, until confusion and anarchy prevail. Among other unfavorable influences are overwork, insufficient sleep, the excitement of life in society, alcoholic excesses, and frequent coitus.

During the recent war it was noticed that underfed women bore large children, but the writer urges that fasting and dieting are quite different. He recently employed his regimen in a gravida who had previously borne a 3500-Gm. infant and the child weighed but 2600 Gm. Prochownick (*Zentralbl. f. Gynäkol.; Med. Rec.*, Apr. 27, 1918).

The writer deems especially valuable in pregnancy the earthy salts and fruit acids contained in **vegetables** and **fruits**. Fruits and fruit pulp and fruit acids are the best possible laxatives for a pregnant patient. Where indigestion is annoying and persistent, especially valuable is the **juice of the fresh lime** or **fresh pineapple**. At least 1 quart of good **water** is required in 24 hours, and if the patient's metabolism is deficient a mildly **saline water** will prove of great benefit. **Fresh air** as a means of nourishment is of special importance. E. P. Davis (*Amer. Jour. Obstet.*, July, 1919).

2. TRAUMA.—Injuries of various characters are not inhibited nor prevented by pregnancy. Some of them may be considered mere curiosities; for example, the tearing open of the pregnant womb by the horns of cattle, early delivery by Cæsarean section because of extensive pelvic deformity, kicks in the abdomen and other brutal treatment, penetration of the vagina and uterus by sticks or other hard objects, accidentally or intentionally. All these causes may produce intense disturbance: the de-

livery of the ovum, pain and inflammation, sepsis, and even death.

3. NERVOUS AND MENTAL IRRITANTS.—There are many causes of this nature which produce disturbance of one kind and another during the pregnant state. Sudden emotions of fear, surprise, grief, anger, etc., may produce unusual results, owing to the extreme sensitiveness which many women experience while pregnant. With one woman the result will be a general sense of pain or a neuralgia in some particular nerve or set of nerves. With another the result will be nausea with or without vomiting, with another diarrhea, while with others the uterus will be excited to contraction and its contents expelled. A very common result from such excitants is incontinence of urine, the urine being voided involuntarily with the slightest nervous or mental impression of an unusual character. The birthmarks or stigmata with which many children come into the world are often traceable only to mental impressions or a disordered imagination, and many of the monstrosities among infants may be fairly accounted for in this way. A woman whose mind is diseased may produce a persistent impression upon her unborn child which will manifest itself at a later period upon the child's physical or mental structure. Women with organic disease of the nervous system may so impress their offspring that they will succumb during the gestation period, or if carried to term will be of such defective structure that their entire lives will be burdensome to them.

4. INTERCURRENT DISEASES.—Of this form of irritant the acute and specific infections furnish a familiar

example. Any acute disease developing during pregnancy may not only be of a more severe type than would ordinarily occur, thus intensifying the patient's discomfort and suffering, but it may even cause the death of the child or its premature delivery, either alive or dead.

From our own viewpoint their influence is about as follows:—

Smallpox complicating pregnancy is more serious than at other times, the hemorrhagic form being particularly fatal. This disease has an injurious effect upon the product of conception, the occurrence of abortion or premature labor varying with the severity of the case, being almost universal in the hemorrhagic and comparatively frequent in the discrete variety.

Although it is generally believed that a certain immunity to *scarlet fever* exists in pregnancy, a number of cases have been reported, and when it occurs in the early months the disease frequently causes abortion.

Measles is not seen very frequently in pregnancy, but has been observed by Klotz to cause premature delivery. It is, however, much more serious during the puerperium than during pregnancy.

Cholera does not attack pregnant women more frequently than others; however, it is more fatal in these cases, Schütz giving a mortality of 57 per cent. in the Hamburg epidemic of 1892.

The incidence of *typhoid fever* is of serious import, and often dangerous. The fetal mortality is greatly increased, abortion or labor occurring in from 40 to 60 per cent. of the cases.

Pneumonia is another complication of pregnancy in which the maternal mortality is high, the disease frequently leading to premature labor or abortion.

The effects of *influenza* on pregnancy vary with the severity of the epidemic, a very pernicious influence being observed by Felkin and Müller, the interruption of pregnancy being preceded by profuse metrorrhagia. In a series of cases reported by Bar and Boullé, however, as well as by Ahlfeld, the disease influences gestation but slightly.

Erysipelas is a very serious complication and particularly dangerous in the pregnant state, the possibility of a streptococcic puerperal infection being markedly increased, though it does not occur invariably.

A general *septicemia* sometimes results from a streptococcic angina, and streptococci may be observed in the uterine lochia, as well as in the fetal blood.

Although the occurrence of *gonorrhea* in the pregnant state is not to be lightly considered, its appearance during labor or during the puerperium is of greater significance. After labor the gonococci may reach the uterine cavity and give rise to fever. Although rarely fatal, this condition is always serious, frequently involving the uterine appendages and causing sterility or necessitating future operative interference.

Tetanus, always a very dangerous disease, is rarely observed during pregnancy, and its prognosis is not influenced by this condition.

Anthrax, though rarely observed in human beings, is almost always fatal. Three deaths are reported in pregnant women by Rostowzen, anthrax

bacilli being demonstrated in the tissues of the child. Several other cases have also been reported.

The ordinary forms of *malaria* have but little influence upon the course of pregnancy; the pernicious form, however, may exert an injurious effect. There is a marked tendency to recrudescence of the disease during pregnancy and the puerperium.

5. IRRITATING CONDITIONS ASSOCIATED WITH THE OVUM.—Such conditions may consist in disease which has been transmitted from the mother (e.g., *syphilis*), or there may be diseased conditions of the placenta or membranes which may react upon the mother. Especially if death of the ovum takes place and it then remains within the mother's body, it may be a source of disturbance to her. One of the most distressing illustrations of such possibilities is the wide range of untoward phenomena which are connected with ectopic gestation.

DISORDERS OF PREGNANCY.

These include the following conditions: vomiting, toxemia, pyalism, displacements of the uterus, embolism and thrombosis, ectopic gestation, pruritus vulvæ, edema of the external genitals and of the upper and lower extremities; disorders of the thyroid, lymphatics, and adrenal glands; hemorrhoids, uterine pain or cramps, spurious pregnancy, concealed pregnancy.

NAUSEA, VOMITING, AND TOXEMIA.

Cases of vomiting naturally fall into two classes, one in which the vomiting merely accompanies the pregnancy and the other in which

pregnancy is the pathogenic factor. It is essential that these two classes be recognized and differentiated.

Vomiting Associated with Pregnancy.—Cases of vomiting occur during pregnancy which are due not to it but to acute intestinal obstruction, appendicitis, gastric carcinoma or ulcer, brain-tumor, or ovarian cyst with twisted pedicle. These cases diagnosed only on a post-mortem examination or when induction of labor has failed to relieve the patient are important, as they are generally thought to be toxemic in origin. Among the diseases which have given rise to error in diagnosis, other than those already mentioned, are: tuberculous peritonitis, strangulated Meckel's diverticulum, chronic alcoholism, hepatic carcinoma, gangrenous typhlitis, septic bronchial glands, and choriocarcinoma of the brain, kidney, and liver. In view of these diagnostic pitfalls a post-mortem examination should be made in all cases of patients who die from so-called toxemic vomiting.

Vomiting of Pregnancy.—For a number of years it has been the custom to divide the cases of vomiting due to pregnancy into three classes: those due to some disturbance of the nervous system, *neurotic vomiting*; to some uterine displacement, *reflex vomiting*; or to some disturbance of protein metabolism, *toxemic vomiting*.

The *neurotic form* has been ascribed to an irritability of the extensive nerve-supply of the uterus subjected to the unusual stimulus of pregnancy.

The disturbance begins soon after the uterus begins to enlarge, and continues with more or less persistency until the uterus is well out of the pelvis; that is, until the sixth or

seventh month of gestation, or even until its termination. It is familiarly known as "morning sickness," being apt to manifest itself when the patient awakens in the morning. If she remains quiet in bed nausea may be the only symptom, and even this may be wanting, but when she rises and makes any effort, nausea with vomiting may result. The ingestion of food usually adds to the discomfort. It may be quickly rejected or may become a disagreeable burden to be thrown off at a later period, or eventually it may be digested and assimilated. The symptom may become so troublesome that the resulting weakness and malnutrition prohibit attention to the daily duties. The patient may be obliged to keep her bed, and even her life may be in danger from inability to retain sufficient nutriment.

The cases of *reflex vomiting*, closely allied with the preceding group, have been described as those in which the vomiting, due to some displacement of the uterus, ceases when the displacement is corrected.

The *toxemic form* of vomiting has been recognized as being due to autointoxication, and when slight, as the condition usually is, it is again called morning sickness. When severe it is known as *hyperemesis gravidarum*, or "pernicious vomiting of pregnancy." The latter condition occurs generally in the first half of pregnancy, differing in this respect from eclampsia, which usually occurs in the latter half of pregnancy. It may be either acute or chronic. *Acute* cases are rare, and a fatal issue takes place usually in from ten to fourteen days. There is no fever; the pulse is little, if at all, accelerated, and ema-

ciation is not marked. The quantity of urine voided is large and it contains blood; the ammonia coefficient is very high. The *chronic* cases may last for several weeks. Three stages are observed—wasting, pyrexial, and mental. In the wasting stage the patient rapidly emaciates. The vomiting varies in frequency from several times a day to instant ejection of all food swallowed. Thirst is marked and there is more or less abdominal pain. The pyrexial stage is marked by a rise of temperature to 103° F. (39.4° C.) or beyond. The pulse is 120 or more. The tongue becomes dry and brown. Diarrhea may be present. At this stage abortion frequently occurs or the uterus is emptied by the physician. In either case recovery is the rule, otherwise the mental stage, marked by delirium or coma, appears and the result is nearly always fatal.

As a matter of fact, more recently there has been a tendency to discard the purely neurotic type of the vomiting of pregnancy, a strong suspicion having arisen that the vomiting may, perhaps, be *always* in some degree of toxic origin, though frequently aggravated by neurotic, including reflex, conditions. The symptom is regarded as one of the manifestations of the toxemia of pregnancy, the latter, in turn, having been variously accounted for on the basis of insufficient hepatic activity, toxic absorption from the bowel, invasion of the maternal organism by syncytial toxins, lack of secretion from the corpus luteum, renal impairment, a deficiency of carbohydrates in the diet, etc.

There are described an *early toxemia* and a *late toxemia* of pregnancy, the first of which is manifested chiefly,

though not wholly, by nausea and vomiting, while the latter comprises manifestations the culminating fury of which is seen in the eclamptic seizure (see PRE-ECLAMPTIC TOXEMIA, p. 604, this volume). It seems most probable that the early toxemia is of syncytial, or placental-cell, origin; the late toxemia is primarily of fetal origin, but may be influenced or aggravated by syncytial products, as well as by extra-genital poisons such as those from the gastrointestinal tract.

The theory of intoxication by the growing ovum during pregnancy is verified most plainly by the demonstration of Schmorl that foreign fetal material in the form of small pieces of syncytial protoplasm may appear in the maternal circulation. In all healthy women, it is believed, most of the toxin is counteracted through the immunizing activities of the mother. Where such immunization, however, is imperfect, the toxic material continues to circulate in the blood-stream in undue amount, and in many instances, among the earlier evidences of this condition, nausea and vomiting are produced, owing to direct irritation of the nerve center concerned.

Changes in the liver are clearly recognized, according to F. D. Lynch, in the pathology of the vomiting of pregnancy. Mild cases, dying of some other condition, show little more than a cloudy swelling of the liver parenchyma, but all or nearly all fatal cases show decided structural changes, varying from simple fatty degeneration to acute yellow atrophy.

The different pregnancy toxicoses are all consequences of the passage of proteinogenous amines or their cleavage products into the blood stream. The amines come from the placenta, the bowel, or the endocrine

glands, especially the pituitary-suprarenal system and the thyroid. The writer's researches have demonstrated the presence of these amines in the blood. They are probably of the histamin type. When the liver becomes exhausted by the excessive work imposed on it, the unmodified amines have a toxic action, which is felt predominantly in the organs which are the less resistant in the individual. If the retinal vessels feel the spasm, there is disturbance in vision; if the cerebral vessels are affected, we have eclampsia. Edema, nephropathy and eclampsia are merely different degrees of the same disturbance. Hussy (*Schweizer med. Woch.*, Oct. 7, 1920).

In serious toxemic vomiting the urine is scanty and may contain albumin, casts, blood, acetone, and diacetic acid. Marked variations in the excretion of nitrogenous substances may occur. The ammonia coefficient, normally 3 to 5 per cent., may be raised to 10 up to 46 per cent (Berkeley and Bonney). While influenced by diet, medication, and other factors, ammonia excretion is regarded as a serviceable index of the degree of functional adequacy of the liver. It is increased in the presence of acidosis and is asserted to serve the purpose of saving alkali for the body. According to J. L. Williams, toxic vomiting is associated with a marked increase of the uric acid in the blood, while nervous vomiting is not.

In the blood of patients with eclampsia, hyperemesis gravidarum, and with the symptoms of pre-eclamptic toxemia, together with arterial hypertension, the uric acid is markedly increased. Delivery and recovery from the symptoms are associated with a gradual return of the uric acid in the blood to its normal amount. It seems possible to differentiate toxic and nervous vomiting of pregnancy by quantitative esti-

mations of the uric acid in the blood. J. L. Williams (*Jour. Amer. Med. Assoc.*, May 7, 1921).

The well known participation of the liver in the disturbance in many of these cases, due to its unsuccessful efforts as detoxicating organ to get rid of the excess of toxic material circulating in the blood, lends importance to the living habits of the patient, indicating in particular how dietary indiscretions might, by overburdening the liver, initiate or aggravate the disorder.

PROPHYLAXIS.—The "morning sickness" of pregnancy, of whatever degree of severity, need no longer be considered a physiologic condition that must be expected and endured, but is a disorder which is either wholly preventable or reducible to a negligible minimum—provided the physician is able to see his patients and control their manner of living as soon as they suspect pregnancy or begin to experience morning sickness as a first evidence of toxemia.

In a very large percentage of cases the digestive tract holds the balance of power, as it were, in the struggle that is ever present in the pregnant woman between the toxins of pregnancy, of whatever nature they may be, and the protective ferments of her blood. Especially is this true of the late or "pre-eclamptic" toxemia. Barring the relatively few cases in which organic disease is known to exist, if the intestinal tract can be kept normal and clean, without resorting to the very common and pernicious use of purgatives, the natural protective forces will maintain the ascendancy and there will be little or no evidence of the presence of toxemia. Again, very real dangers arise in this connection from the pernicious practice of overeating or injudicious

eating, a practice indulged in by the pregnant woman, like every one else, particularly in the midwinter holiday period and the midsummer vacation season. Hospital records clearly show a decided increase in the number and severity of eclampsia cases at these two seasons of the year.

Undoubtedly, the most effective measures that can be applied for the prevention of pregnancy toxemia consist of definite, practical instructions on *how, when, and what to eat and drink*.

Careful observation and experience extending over a number of years have convinced the writer of the great value and efficacy of the following routine instructions which he issues to the pregnant woman:

(1) The entire food allowance for the 24 hours is to be divided as nearly as possible into 5 equal portions, to be taken every 3 hours. No other food is to be taken *after* or *before* or *between* these meals. There is to be no "big meal," and especially not the usual evening dinner.

(2) The patient may have a fairly liberal variety of foods as long as they are known to be nutritious and digestible. Her drink is to be limited almost entirely to water and milk, the latter to constitute the basis of each of the 5 meals; 5 glasses of milk a day, with good bread and butter, some of the breakfast foods or cereals, with plenty of cream and sugar; properly cooked potatoes; green vegetables, such as lettuce, spinach, or celery; a moderate amount of good fruits, occasionally an egg, a small portion of fish, or even a small allowance of red meat 2 or 3 times a week.

(3) As often as she eats, or 5 times a day, she is to take at least a half teaspoonful of **bicarbonate of soda**, or its equivalent in some other alkali, such as the **milk of magnesia**; this alkali is to be increased or decreased according to its effects on the reaction of the urine and the general condition of the patient.

Of course, much more than this, and much that is different from this, must often be said to suit individual cases. The general plan, however, constitutes the most effective means the writer has ever found to prevent overeating. More women come to grief from eating too much than from eating too little, but the plan above outlined, if properly followed, prevents both overeating and undereating. The amount of sodium bicarbonate to be given is that which will maintain slight alkalinity of the urine.

TREATMENT.—In the active treatment of the vomiting and toxemia of pregnancy, **rest** is an important measure. Rest in bed may, in the milder cases of nausea and vomiting, be all that is required, the woman gradually resuming her customary duties as the stomach becomes less irritable.

In more obstinate cases, including those of pernicious vomiting, the writer has had uniformly good results for years from a plan of treatment consisting of rest in bed for a week or two combined with certain dietetic and pharmacologic measures: For the first 3 days or longer, **no food by mouth** is allowed, the patient being given by **Murphy drip**, after an initial cleansing of the bowel with copious **enemas**, a solution consisting of **sodium bicarbonate**, 6 drams (24 Gm.), **sodium bromide**, 2 drams (8 Gm.), and **glucose**, 2 ounces (64 Gm.), to the quart (950 c.c.) of **normal saline solution**. This drip treatment is given for 3 hours at a time, at intervals likewise of 3 hours, and continued until the quantity and quality of the urine are satisfactory. Meanwhile nothing is given by mouth except water containing **sodium bicarbonate**, 10 grains (0.6 Gm.) to the ounce (30 c.c.),

which is given freely, partly for the purpose of washing out the stomach when the patient vomits.

After the desired relief has been obtained the patient is allowed food when she wants it, and of practically whatever kind she desires. Sufficient alkali is continued by the mouth, however, to cause the urine to remain alkaline in reaction.

Under this treatment the condition nearly always improves rapidly, even in "pernicious" vomiting. The results obtained are so uniform that the writer has not found it necessary to empty the uterus in such cases for many years.

The writers believe that a deficiency in carbohydrates has an important bearing on the origin of toxemia of pregnancy. Pathologic changes in the liver lobules similar to those of fatal toxemias of pregnancy can be made to disappear rapidly by ingestion of **carbohydrates**. Mild cases of nausea and vomiting may be controlled by giving a preponderance of carbohydrates, and taking food more frequently than usual. The patient should also be given from 8 to 16 ounces (240 to 480 c.c.) of 10 per cent. **glucose** and 2 per cent. **sodium bicarbonate solution** daily by mouth in 1- or 2-ounce (30- or 60-c.c.) doses. In more severe cases, after an initial period of **rest, gastric lavage** and **saline cathartics through the stomach tube**, small amounts of **liquid food** are allowed, alternating with from 1 to 2 ounces of the glucose and soda solution, every 2 hours. In seriously toxic patients intravenous injections of 15 to 25 Gm. (4 to 6½ drams) of glucose in 250 to 300 c.c. (½ to ¾ pints) of water, are given 1 to 3 or more times daily. Titus, Hoffman and Givens (Jour. Amer. Med. Assoc., Mar. 20, 1920).

Insulin used in 8 cases, together with **glucose intravenously**. All the cases had a marked ketonuria, the

rapid eradication of which by this treatment seemed to cause relief of the nausea and vomiting. Thalheimer (Surg., Gyn. and Obst., Aug., 1924).

Stress laid on the factor of dehydration in hyperemesis. All cases are given at once **intravenously** 1000 c.c. of 5 per cent. **glucose** solution in 1 per cent. saline solution, to be repeated daily until diuresis is obtained. Also, **enemas** of 10 per cent. **glucose** in normal salt solution are given 3 times daily, and at bedtime 30 to 60 grains (2 to 4 Gm.) of **sodium bromide** are given in each enema for the first day or so. No attempt is made to feed solids by mouth, but **fluids** are urged. Usually, within 3 or 4 days, marked improvement results. V. J. Harding and H. B. Van Wyck (Amer. Jour. of Obst. and Gyn., Jan., 1926).

Another procedure that has proven of value in severe cases is the administration of 20 c.c. of inactivated **blood serum** of a non-toxic pregnant woman.

Injections of the **husband's whole blood** used in 8 cases with excellent results. Thirty c.c. of his blood are collected in 10 c.c. of 10 per cent. sodium citrate solution and kept in the ice-box. Intramuscular injections are given daily for 5 days, starting with 2 c.c. and ending with 10 c.c. W. S. Horn (Tex. State Jour. of Med., July, 1925).

Horse serum in doses of 5 drams (20 c.c.), repeated as required, has been successful in some cases.

Among other measures that have been availed of in the past but are now rarely, if ever, indicated in view of the successful results obtained from the above treatment are:

Bismuth subnitrate by the mouth; **wine of ipecac**, 5 minims (0.3 c.c.) in an ounce (30 c.c.) of water every four hours; **liquor acidi arsenosi** in small doses; **bromides** in large doses; **barbital**, 20 grains (1.3 Gm.) by the rectum; **chloral hydrate**, 20 grains (1.3

Gm.); silver nitrate, $\frac{1}{4}$ grain (0.16 Gm.) in capsules; menthol, 2 grains (0.13 Gm.); cocaine, $\frac{1}{2}$ grain (0.03 Gm.) and monobromated camphor, 3 grains (0.2 Gm.) in a capsule; adrenalin, 10 drops of the 1:1000 solution in normal saline solution, and washing out the stomach with large amounts of warm water or saline solution every morning. H. E. Miller gives luminal-sodium, 2 grains (0.13 Gm.) one hour before each meal and at bed time.

Corpus luteum injections have been used with considerable success by Hirst and other observers.

The pituitary and suprarenals play an important part in pregnancy disturbances. Severe hyperemesis at the second month and eclampsia at the ninth month in 2 primiparae treated with ovarian extract showed marked benefit. The extract should be given early and freely. Hofbauer (*Zent. f. Gynäk.*, Feb. 7, 1920).

Intravenous administration of corpus luteum advised. Ampoules containing 0.2 Gm. of the dried substance in solution in 1 c.c. of salt solution are available for this purpose. Ambulatory patients usually receive 2 c.c. every other day. More severe cases receive 2 c.c. daily, given at home; pernicious cases, 2 c.c. twice daily. All patients should receive at least 12 c.c. J. C. Hirst (*Jour. Amer. Med. Assoc.*, Mar. 19, 1921).

Suggestion has been commended by Atlee and others.

If the patient does not respond to any of the measures mentioned, but continues to grow worse, if the ammonia content is increasing or is over 10 per cent. and the clinical signs and symptoms of the fever stage are marked, labor should be induced (Berkeley and Bonney).

Painting the os uteri with tincture of iodine arrests the vomiting at once, in most instances. One application is

usually enough. Johnson (*Amer. Jour. of Clin. Med.*, June, 1917).

TOXEMIA OF PREGNANCY.

The condition sometimes termed "pre-eclamptic toxemia"—owing to the frequency with which it is followed by convulsions (see PUERPERAL ECLAMPSIA, page 722, this volume)—or the "late toxemia of pregnancy," is due to the presence in the blood of poisonous substances, maternal and fetal. The former are believed to be toxic wastes of hepatic, renal or systemic origin; the latter waste or by-products excreted by the fetus or placenta, owing probably to defective hydrolysis. Foci of infection in the tonsils, teeth, kidneys, or intestines have also been incriminated.

SYMPTOMS.—The early symptoms of pregnancy toxemia are persistent headache, located mainly about the forehead, and sometimes severe, muscae volitantes, and more or less persistent epigastric pain, often accompanied by nausea and vomiting, and vertigo. Constipation and the converse, diarrhea, may also occur. The urine is usually voided in reduced volume and often contains albumin. It is sometimes necessary to examine a catheterized specimen. The nitrogen excretion is lowered.

The toxemia becoming more defined, the tongue, previously coated, becomes dry and red, the gums likewise red, and the skin, particularly that of the face, muddy. A blood-pressure of 160 or over, and a high tension pulse are also common. Insomnia and disturbances of vision, irritability, and twitching, are frequent. The presence of edema, especially including the eyelids, upper extremities and labia, denotes a severe case.

Of 523 pregnant women, 104 had at some time during their pregnancy a systolic pressure of 140 or more. Such hypertension is a fair index of the onset of toxemia. Of the patients with hypertension below the age of 30, 72 per cent. had toxemia, as against 54 per cent. of those above 30. R. D. Mussey and L. M. Randall (Minn. Med., Sept., 1924).

TREATMENT.—The aim in these cases is to prevent eclampsia (*q.v.*) by reducing the formation of wastes and promoting their excretion. Absolute **rest in bed**, a **milk diet** and eliminants, such as **magnesium sulphate** until free purgation is produced, **large quantities of water** as beverage, colonic irrigations with **hot saline solution**, and also, to promote elimination by the skin, **hot baths**, and if eclampsia threatens, **hot pack**. **Bland foods** and **avoidance of meats** will tend to prevent convulsions. This is also aided by **gastric lavage** with a solution of **sodium bicarbonate**, a procedure which as a rule promptly relieves the gastric pain. A powder containing 10 grains each of **sodium bicarbonate**, **bismuth carbonate** and **calcined magnesia**, given in a glassful of water every three hours, opposes acidosis, a prominent factor in the production of convulsions. If the latter threaten, **venesection** followed at once by **intravenous infusions of saline solution** will do much to prevent them. **Elimination of infectious foci** may be necessary. Striking results from the **removal of dental abscesses** have been reported.

If a blood-pressure which has been below 120 mm. Hg starts to rise, other symptoms of toxemia may be expected soon if the patient remains without rest and dieting. At 150 mm. albumin appears in the urine and eclampsia is imminent. Since tox-

emia can usually be prevented by **rest** and a **milk-vegetable, salt-free diet**, it is very important to look for this early sign. V. le Lorier (Presse méd., Jan. 6, 1923).

In pre-eclamptic toxemia, **intravenous injection of 20 c.c. (5 drams) of 10 per cent. magnesium sulphate** solution nearly always yields immediate relief from the subjective symptoms. It is usually followed by some reduction of blood-pressure and of edema—probably including cerebral edema—and an increased output of urine. L. G. McNeile and J. Vruwink (Jour. Amer. Med. Assoc., July 24, 1926).

In pre-eclampsia **salt restriction** is of benefit to the mother. At first, salt should be completely withdrawn; then, when no further benefit accrues, 3 Gm. of salt may be added to the diet. For prophylactic purposes one salt-free week in four may be added to the customary prenatal care. V. J. Harding and H. B. Van Wyck (Jour. Obst. and Gyn. of Brit. Emp., xxxiii, 17, 1926).

If all prophylactic measures fail, **emptying of the uterus** may become imperative.

All other measures failing, the final resort is to **empty the uterus** under ether anesthesia. Preliminary gradual dilatation with Hegar's dilators up to No. 20 should be effected. If at term, the Voorhies bag No. 4, introduced by Reed's method as a cigarette roll held by Péan's forceps, is useful. **Lavage** with 2 per cent. **sodium bicarbonate** solution after emptying the uterus is advocated. Mosher (Amer. Jour. of Obstet., Dec., 1918).

For the treatment of eclampsia see PUERPERAL ECLAMPSIA, this volume.

PTYALISM.

This consists in an irritability of the salivary glands, in which the saliva is poured out in an almost constant stream. It is apt to occur with primiparæ, and in the first three or

four months of pregnancy. Its effect is to weaken the patient and impair the digestive function. The quantity of saliva secreted in the twenty-four hours may amount to one or more pints. The saliva may be purely fluid or watery, or it may be mingled with an abundance of mucus, and be thick and ropy. This disorder is more common in the earlier months of pregnancy and is often associated with vomiting, and is considered to be a reflex neurosis in some cases, while in others an auto-intoxication. The patient's health may suffer if the ptyalism is profuse.

TREATMENT.—There is no remedy for this trouble which compares with **atropine sulphate**. It may be given in $\frac{1}{30}$ -grain (0.0005 Gm.) doses repeated every three or four hours until physiological effects are apparent. An alkaline and astringent **mouth-wash** composed of **alum** 1 dram (4 Gm.) to 1 pint (500 c.c.) of water, is useful in conjunction with the atropine treatment.

In severe cases a **strict milk diet** should be ordered, with careful **regulation of the bowels**, with a view of preventing auto-intoxication. **Ovarian therapy** was found useful by Boissard.

In a case of toxemia of pregnancy with sialorrhea and ulcerative stomatitis, boiled cow's **milk** was **injected** in the gluteal muscles, 5 to 10 c.c. ($1\frac{1}{4}$ to $2\frac{1}{2}$ drams) at a time, at an interval of 1 to 3 days, prompt relief resulting. In 3 cases of obstinate vomiting, 2 or 3 milk injections caused marked improvement. G. Levi (Ann. di ost. e ginec., Feb., 1922).

DISPLACEMENTS OF THE UTERUS.

Uterine displacement may be present when pregnancy is initiated or it

may be acquired during any period of gestation. It may be lateral, anterior, or posterior, and it may be more or less exaggerated. It may be simple, or it may be complicated by adhesion of the peritoneal surface to the contiguous peritoneum. Whether the adherence exists at the beginning of pregnancy or is acquired subsequently, it is always an unfortunate—not to say a dangerous—complication in so far as the continuance of pregnancy is concerned.

The least significant, in so far as disturbance to the pregnant state is concerned, are *lateral* displacements. If there are no adhesions the uterus usually corrects itself as pregnancy advances, and if no other complication supervenes parturition will follow in the natural sequence and involution will restore the organ to its normal place and relations in the pelvis. If adhesions exist or are acquired, they may be pulled apart as the uterus enlarges, or their firmness may be such that they will not yield, uterine contractions being excited and the uterine contents expelled, or the latter may require removal at the hands of the physician.

Anterior displacement may be slight or extensive and the uterus may or may not be adherent to the bladder. If the displacement is slight and there are no adhesions, spontaneous correction will result as the uterus enlarges and no further difficulty from this source may follow. When the displacement is extensive, the subsequent enlargement of the uterus will be asymmetrical, the function of the bladder will be encroached upon, and there will be constant irritation of that viscus, with frequent micturition, and possibly the development of an

annoying cystitis. This may continue until the end of pregnancy, or the irritation may be so great that uterine contraction and abortion will result. The danger of this mishap is greatly increased if the uterus has become adherent to the bladder. After the uterus has been emptied the union to the bladder may persist with such annoying symptoms that a surgical operation may be required to effect relief.

When the uterus is displaced *posteriorly*, the difficulties and dangers will usually be greater than in either of the other varieties of displacement. It may be merely retroverted or acutely retroflexed. If the former, and there are no adhesions, nature may again correct the trouble and no further difficulty ensue. If adhesions are present, the enlargement of the uterus will almost certainly produce such irritation that contractions and abortion will follow.

Among 24,000 pregnant women Martin found 121 cases of retroversion and retroflexion, and in 94 cases retroversion persisted after repeated pregnancies.

In acute retroflexion the displacement may be remedied as it enlarges, but too much cannot be placed upon the unaided effort of nature. It will be far better to place the patient in the **knee-elbow position**, restore the organ to its normal position with the fingers, and then secure it with a **tampon** or a suitable pessary.

Many cases are susceptible of relief by such means which would otherwise terminate in abortion. If the uterus is retroflexed and also fixed by adhesions, relief may be obtained by the judicious use of the **tampon** or **pessary**, or the ad-

hesions may be liberated as the organ enlarges; but in the majority of cases an abortion will be the result. With this displacement there are usually various annoying complications: The rectum is irritable from the constant pressure upon it and a troublesome diarrhea or an equally troublesome constipation may ensue. Relief will come only when the cause has been removed. The bladder may also give trouble, owing to the constant traction at its neck, and the patient will be distressed with constant desire to micturate, each effort being followed by tenesmus. All things considered, uterine displacements bring about as much discomfort as any of the disorders to which the pregnant woman is subject.

Of 1000 women, 18.8 per cent. had retrodisplacement while under observation during pregnancy or the puerperium. In those giving no history of abortion, no treatment was given unless the periodic examinations showed that the uterus had risen out of the pelvis or was prevented from doing so by the promontory. In the latter event, **manual reposition** was tried, and usually sufficed. If not, **Schulz's maneuver** was employed, the posterior lip of the cervix being seized with forceps and traction made on the latter, while with the fingers in the vagina upward pressure was made on the fundus. When the fundus passed the horizontal plane the cervix was pushed back, the forceps removed, and the fundus pushed forward by one hand abdominally while the other kept the cervix back. Usually this simple procedure sufficed. A **pessary** was then introduced, to remain until the uterus was too large to reënter the pelvis. The patient remained in bed 2 days and was given $\frac{1}{2}$ grain (0.03 Gm.) of **codeine** at once and again in the evening. Danforth and Galloway (Jour. Amer. Med. Assoc., Sept. 11, 1926).

EMBOLISM AND THROMBOSIS.

Pregnancy is often attended with enlargement of the veins, those of the lower extremities and vulva being most frequently implicated. The condition is less common in primiparæ than in multiparæ. If the vascular tension be weak the formation of thrombi is favored. Portions of these thrombi may be detached as emboli and, passing onward, may find their way into the arterial circulation, especially into the arteries of the lungs and brain. When arrested in these vessels the most violent symptoms may ensue: pain, dyspnea, effusion, even death. Such accidents, however, are more frequently the sequences of labor, especially when the thrombi are formed within the uterus at the site of the placenta. Pregnant women who suffer with varicose veins should always be cautioned against violent exertions or anything which would tend to the formation of thrombi, or to their disintegration when formed.

TREATMENT.—The treatment in such cases must necessarily be expectant and stimulating, the patient being kept **in bed** most of the time upon **fluid diet**. If it is necessary or desirable that she should be up and around, the **feet and legs** should be **bandaged** (the elastic crêpe bandage is best), but not too firmly.

ECTOPIC GESTATION.

Although this condition rarely occurs as a complication in conjunction with an intrauterine pregnancy, such cases are not unknown.

Instance of intra-uterine and extra-uterine twin pregnancy. The patient was in her third pregnancy, her first having been twins with dead children

of the same sex. The second pregnancy terminated in normal labor. During the second month of the third pregnancy she had violent pain in the lower abdomen with shock. Pregnancy continued, however, until near term, when she gave birth in spontaneous labor to a male fetus 45 cm. long. An hour later she complained of severe pain in the lower abdomen, which gradually ceased and returned the following day. She was admitted to hospital with a diagnosis of ectopic pregnancy. On examination a fetus could be palpated in the abdomen, and heart sounds could be heard. This was confirmed by **operation**, a living fetus being found in a sac without amniotic liquid, with pulsating cord and placenta partly adherent to the omentum. The child was rapidly delivered and the placenta was removed with unusual facility. Bogdanovics (Zentralbl. f. Gynäk., Nu. 22, 1914).

When tubal pregnancy ends, the uterus undergoes involution: (1) by destroying recently developed tissue, and (2) by reconstructing new and normal tissue. The first takes place by free hemorrhage from the endometrium, with destruction of cells and filling of venous spaces. In the tube a similar process goes on, so that chorionic villi may remain in active condition in the tube indefinitely. Sampson (Surg., Gynec. and Obstet., May, 1914).

In reviewing 100 cases reported in the literature in which pregnancy had continued for more than 24 weeks, the writer found that 77 per cent. went to term. The pregnancy was normal in 33 per cent. of the cases. In 50 per cent. there were abdominal symptoms, probably at the time of rupture or hemorrhage. In 1 case eclampsia developed during labor. In 3 per cent. of the cases there was extra- and intra-uterine pregnancy. Seventy-four of the patients were not operated upon and there were no complications. In 33 per cent. there were symptoms of infection. These symptoms occurred as early as 10

days and as late as 15 years after labor or the death of the fetus. Ley (Proc. Roy. Soc. Med., London, Sect. Obstet. and Gynec., xii, p. 140, 1919).

Rupture of the sac having already been treated in the first volume by Dr. John B. Deaver, under the title ABORTION, TUBAL, it will only be briefly reviewed in the present connection.

The sac ruptures, as a rule, from the sixth to the tenth week of its history and it would be almost an impossibility for ectopic gestation to occur after uterogestation had been established. If, therefore, the two conditions coexist, the former will usually begin coincidently with the latter or a short time—a few weeks—previously. Uterogestation usually causes the abeyance of menstruation, but when it coexists with ectopic gestation one of the first symptoms indicative of the situation will be hemorrhage; this may appear at the customary time for menstruation, thus misleading the patient with regard to her condition, or it may appear a few days or weeks subsequently. But it will differ from the customary menstrual flow by its continuance after the usual duration, and also by its greater abundance. This fact may serve to warn the patient that her condition is not that which attends ordinary menstruation. The bleeding may or may not be attended by the discharge of shreds of decidua, this being by no means a constant symptom.

A study of 147 cases of extra-uterine pregnancy showed that 19 per cent. occurred in primiparous women; 8 per cent. were illegitimate pregnancies; 30 per cent. had a history of previous abortion; and that in 28 per cent. the preceding pregnancy

had terminated prematurely. The average interval after an intra-uterine pregnancy until the extra-uterine pregnancy developed was 45 months. The average interval between the 2 attacks in the 7 cases in which the condition was repeated was 2 years. Recovery was noted for each of the 17 patients operated on in shock. Sterilization was performed 18 times; in 8 of these cases the opposite tube had been previously removed; 30 cases (52 per cent.) of the 58 cases whose subsequent history is known did not develop any later pregnancies; 39 intra-uterine pregnancies have developed subsequent to the extra-uterine condition, 28 ending at term, 8 aborting, while 3 are at present pregnant. The extra-uterine pregnancy was repeated 7 times, a ratio to the intra-uterine pregnancies of 1 to 5.5. Williams (Amer. Jour. of Obstet., June, 1913).

Pain, due to both a stretching of the abnormal gestation sac and its subsequent rupture with hemorrhage either into the peritoneal cavity or into the space between the folds of the broad ligament, is suggestive. It is sharp and cramp-like; recurs in frequent paroxysms, and may be so severe that it, in connection with the accompanying concealed hemorrhage, may result in anemia and collapse. If the rupture occurs at a very early period the fetus (ectopic) may die and be absorbed together with the effused blood. The uterine gestation may terminate with an early abortion; but this rule need not be considered invariable.

Valuable early symptom of extra-uterine gestation in certain cases. If at the first examination there is nothing present in Douglas's pouch, while later there is an increase in resistance, the diagnosis of an extra-uterine gestation may be made. Case in which the writer made the diagnosis, although the Abderhalden reaction

proved negative. At the operation there was found a small clot in Douglas's pouch, and just above on the right side was a tubal gestation sac. Close to the abdominal end of the tube was a small opening through which blood had oozed. Solowij (Zentralbl. f. Gynäk., Nov., 1913).

The writer resorts to **posterior and anterior colpoceliotomy** to aid him in diagnosing ectopic gestation in difficult and doubtful cases. The dark-blue shimmer back of the exposed vesico-uterine fold of peritoneum is very characteristic. Bandler (Arch. of Diag., April, 1912).

In cases of jaundice of obscure origin, the discovery of hematin in the blood-serum served to confirm the suspicion of ruptured extra-uterine pregnancy. Schottmüller (Münch. med. Woch., Feb. 3, 1914).

After rupture of a pregnant tube, even if no accumulation of blood in the pouch of Douglas can be palpated, deep palpation will often elicit sharp sudden pain, so that even when the patient is half swooning, it will make her cry out. The contrast between the soft depressibility of the pouch and this severe pain on deep palpation is significant, especially when the rectus muscle shows no signs of contracture. Proust (Paris méd., Aug. 7, 1920).

In doubtful cases, if the patient can be kept under observation for a few days, the writer advocates milk injections. In ectopic gestation the tumor will not change in size or increase, whereas an inflammatory adnexal mass will become smaller. Tkadlecek (Casop. lek. cesk., Dec. 13, 1924).

In early extra-uterine pregnancy sharp pain is felt if 1 or 2 fingers are inserted in the posterior fornix and the portio or whole uterus is pushed toward the symphysis pubis. This induced pain is evidence against criminal abortion or appendicitis. Z. Bánki (Zent. f. Gyn., Jan. 17, 1925).

TREATMENT.—The treatment of this condition has been fully described by Dr. John B. Deaver, in the article on ABORTION, TUBAL, in

the first volume, page 191, to which the reader is referred.

The treatment of abdominal pregnancy was studied in 240 reported cases by the writer, in respect to the best time to operate. After the 6th month the best time proved to be the 10th month. In the last month only 30 per cent. of the fatal maternal cases died of hemorrhage, while before this period 60 per cent. succumbed in this way. From the standpoint of the child the best time to operate was found to be just before the last 2 weeks of pregnancy. The mortality has gradually been reduced to 11.1 per cent. in cases in which the placenta was removed. Such removal should be effected when possible. At operation, the vessels in the placental site should be ligated before removal is attempted. A. C. Beck (N. Y. Med. Jour., June 28, 1919).

In practicing **blood reinfusion** in 24 cases of ruptured extra-uterine pregnancy, the author removed the free blood with a spoon, including the clots. It was then strained through 8 layers of muslin, diluted with an equal volume of salt solution, and kept at body temperature on a water bath until it could be injected through a glass cannula into the median vein, while the surgeon was completing the operation. The blood entered the vein from a height of $\frac{1}{2}$ meter (20 inches) in from 10 to 40 minutes. The average amount used was 520 c.c. (18 ounces). Only blood from a recent rupture is suitable. Some cases seem to be thus saved which would die under simple saline infusion. Töpler (Deut. med. Woch., Jan. 19, 1922).

PRURITUS VULVÆ.

This annoying condition, which occurs in primiparæ as well as in multiparæ, consists in an intense and intolerable itching of the skin of the labia and circumanal region and sometimes the mucous membrane of the vagina. It is especially annoying at night after the patient has re-

tired to her bed. The rubbing and scratching provoked induce excoriation and sometimes severe inflammation of the skin, often lead to the formation of the masturbation habit, and may make the patient's life truly miserable. There may be very little external evidence of disturbance, or the skin may show cracks and abrasions. It is sometimes dry, red, and parchment-like; in other cases it is moist, with transuded serum, and the entire vulva may be swollen, hot, and painful to the touch.

Pruritus vulvæ may be attributed to four principal causes: 1. Discharges from the vagina or cervical canal. 2. Parasites of the skin. 3. Irritation of cutaneous nerve-endings of central origin. 4. Glycosuria.

Discharges from the Vagina or Cervical Canal.—The turgid, congested condition of the vagina and uterus during pregnancy conduces to the hypersecretion of glandular fluid and the transudation of serum from the vessels. This discharge may be bland and unirritating or it may be acrid and corrosive. Want of cleanliness and possibly the action of the bacteria of the skin favor the development of the troublesome condition. The discharge may be white and watery or colorless and slimy, and it may be scanty or abundant.

DIAGNOSIS.—The urine should be examined to exclude glycosuria. *Leukoplakic vulvitis*, which is attended by intense pruritus, should also be excluded. The latter occurs as a whitish thickening of the surface of the vulvæ, especially of the labia minora and the inner surface of the labia majora; later, cracks and fissures appear. The liability of this disease to become carcinomatous in

character makes its early detection important.

TREATMENT.—An efficient measure in the treatment of this condition consists in **drying the skin and mucous membrane** with absorbent cotton, **tamponing the vagina** with cotton-wool soaked with a paste of **glycerin and bismuth subnitrate**, and covering the skin with a thick layer of the same. This should be repeated daily and will usually bring relief.

Ichthyol is indicated in all cases of vulvar pruritus, used either as a 10 per cent. ointment, plaster, or lotion (aqueous).

If the itching is due to cutaneous parasites, these are the ordinary *Pediculi pubis*, which adhere tenaciously to the roots of the hair of the vulva. **Mercurial ointment** rubbed into the skin a few days in succession will destroy them.

When the pruritus is of central origin the cutaneous nerves are irritated, reflexly. Diabetes may produce this condition, though the irritant, in some cases at least, is the urine, which has been allowed to soil the skin. The treatment will consist, first, as in all cases, of **cleanliness**, then the application of the **glycerin-and-bismuth paste** or of **vaselin or zinc ointment** with which a sufficient quantity of **morphine, cocaine, or phenol** (15 grains—1 Gm.—to the ounce—30 Gm.—will usually suffice) has been combined. The causative disease must, of course, receive proper treatment at the same time. The internal use of **bromides** and **ichthyol** are indicated.

According to Pardo, the **X-rays**, in the dose of $\frac{1}{4}$ H. twice a week, are frequently curative.

EDEMA.

Causes of edema are many: **Pressure** of the pregnant uterus on the pelvic veins; renal disease; heart disease; impaction of the uterus or of the fetal head; thrombosis of the femoral or brachial veins; in some cases no definite cause can be discovered.

Edema of the external genitals, the lower and upper extremities, may properly be considered together, for it in all cases results from the same cause,—namely: interference with the venous circulation,—the first being more frequent than the other two.

Edema of the vulva is quite common, the tissue becoming quite dark, sometimes almost black. The veins may be greatly enlarged and the swelling of the tissues so extensive as to be painful and make locomotion difficult. The treatment consists in the application of **cooling** and **astringent** lotions, and **rest in bed** the greater portion of the time. This and the other two conditions are accompaniments of the later months of pregnancy when the weight and pressure of the heavy womb impair the freedom of circulation of the blood-current. Edema of the lower extremities is especially apt to occur with those who suffer with varicose veins of the legs, with cooks and washerwomen, and others whose duties compel them to be standing from morning until night.

TREATMENT.—**Rest in the horizontal position** is all-important. **Bandaging the feet and legs**, the bandage being carried well above the knees, will often give comfort and enable the patient to go about in the pursuit of her ordinary duties. In edema of the upper extremities appropriate treatment of the central cause

and **rest in bed** are imperative. The **limbs** should be lightly **bandaged** from hand to shoulder if the swelling is considerable. When the edema is intense, it may be necessary to **induce labor**. **Southey's tubes** in the legs may accord temporary relief. Where extreme swelling prevents access to the vagina, or would prevent the birth of the child, **multiple incisions** will give relief.

DISORDERS OF THE THYROID, LYMPHATICS, AND ADRENAL GLANDS.

SIMPLE GOITER.—The association of goiter and pregnancy is not rare. Goiter when already present rapidly increases in size on the occurrence of pregnancy, or its first appearance may be during pregnancy.

Symptoms.—Severe attacks of dyspnea usually occur and death has occurred from suffocation. In the puerperium the goiter is subject to puerperal infection, in which case there may be abscess formation within the gland.

Treatment.—The administration of **iodine** in the form of the **tincture** and the **iodides of potassium and sodium** is indicated. **Ionic medication** has been advised—a saturated solution of potassium iodide being applied on the cathode, a current of 25 milliampères being used, and the sitting lasting twenty minutes daily. **Thyroidectomy** entire or partial has been successfully used. In extreme cases **labor** must be induced.

EXOPHTHALMIC GOITER.—This may be present before or develop during pregnancy.

Symptoms.—If previously present, the usual symptoms of the disease

are more pronounced when the patient becomes pregnant. The goiter may rapidly increase in size and demand attention. The increased strain on the heart produced by pregnancy is added to that organ already impaired by the persistent tachycardia. Vomiting, emaciation, and fever are not uncommonly present and, sometimes, jaundice. Exophthalmic goiter is a contraindication to pregnancy and patients should be informed of the dangers incurred. The symptoms often improve, and may disappear, after delivery.

Treatment.—In the milder cases where pregnancy may be allowed to proceed, **absolute rest** should be enjoined, as the pulse is usually 30 or 40 beats less in the recumbent posture. In cases with acute symptoms, or where they are rapidly becoming worse, **labor** should be induced.

If partial **thyroidectomy** or ligation of the **arteries** is considered, the **uterus** should be first **emptied**. If an anesthetic is deemed necessary during the labor, **lumbar puncture** with injection of **morphine** **scopolamine** will be found safer than ether or chloroform. If rapid delivery is indicated, vaginal Cesarean section is to be preferred in the early months; at or near term, the abdominal operation is the best.

MYXEDEMA.—Myxedema is a rare complication of pregnancy. Cases have been reported where women with each pregnancy were in a state of mental apathy, drowsiness, and delayed cerebration, thought to be due to deficiency of the thyroid secretion. The myxedema does not usually increase during pregnancy, and other complications do not appear.

Treatment.—The indications are plainly for the administration of **thyroid gland**, which should be given at first in very small doses and then gradually increased. The **induction of premature labor** must be considered when the disease recurs with later pregnancies. The **patient** should be **warned against** further attempts at **childbearing**.

TETANY.—Tetany in pregnancy has, in a number of cases, been accompanied by symptoms of osteomalacia. By some this complication of pregnancy is said to depend upon the seasons and locality, being more frequent in the first four months of the year and in certain districts and countries. Tetany usually appears during the later months of pregnancy and may persist through lactation. Recurrence in subsequent pregnancies is common.

Symptoms.—The patient has painful and characteristic intermittent contractions beginning in the muscles of the extremities. A feeling of numbness, or a tingling in the parts to be affected, usually precedes the spasms, which are symmetrical. Each attack lasts from a few minutes to several hours. In severe cases the contractions are violent and are followed by marked exhaustion. Pregnancy is not shortened by tetany nor is labor affected. Though annoying, tetany is seldom dangerous, and recovery may be assured. It is important that *tetanus* and tetany be not confounded. In the former the spasm originates in the face and extends to the extremities; the back is also rigidly arched (opisthotonos); the contractions also persist and the mortality is high. *Hysteria* must also be excluded.

Treatment.—Among the remedies found most useful are **parathyroid gland**, calcium preparations, the **iodides**, **chloral**, **opium**, and **chloretone**. **Inhalations of chloroform** may be required during the height of the spasms. **Massage** of the affected parts has a tendency to relieve.

LYMPHADENOMA.—Lymphadenoma, or Hodgkin's disease, may arise during pregnancy, or may antedate it. In the latter case the disease runs a more rapid course, and death may ensue in the latter half of pregnancy or soon thereafter.

Symptoms.—The glands in the neck usually become swollen on one side. Later, other groups of glands are involved; the axillary, bronchial, and mediastinal glands suffer enlargement, as does the spleen and, not infrequently, the liver. Pressure on the bronchi and veins produces a paroxysmal cough, edema, and ascites. Anemia, fever, and emaciation are present. Abortion commonly takes place and the anemia causes retroplacental and post-partum hemorrhage. The disease does not affect the child in any way.

Treatment.—If the disease is localized in the neck, **excision of the glands** may be performed. If it is more generalized, excision is useless. The internal use of **arsenic** and the local use of the **X-rays** have proved valuable in some cases. The **uterus** should be **evacuated** in all instances.

ADDISON'S DISEASE.—Addison's disease as a complication of pregnancy is very rare. The disease, in the cases so far reported, has appeared during the pregnancy; labor was normal, but death from excessive vomiting and collapse occurred about eleven days after parturition. Imme-

diately **induction of labor** would be indicated if a woman having Addison's disease became pregnant.

HEMORRHOIDS.—These cause great annoyance, especially in the later months of pregnancy. They may be regarded as similar in causation to edema of the vulva, and, indeed, may accompany it. They are more frequent in those who have suffered with the same trouble prior to pregnancy than in others; they are common in those who suffer with constipation, and are a source of great pain when the bowels are moved.

Treatment.—The measures indicated in the article on **HEMORRHOIDS** (*q. v.*) apply in the present connection, but, as a rule, surgical measures are required only when the hemorrhoids are very large and pediculated or are the source of unusual pain and discomfort. **Rest in bed** and the use of **astringent and sedative lotions**; careful and **thorough cleansing** of the parts, and the careful **regulation of the bowels** with mild aperients such as **confection of senna**, **cascara sagrada**, or **compound licorice powder** (aloe and other remedies acting on the lower bowel are strongly contraindicated), will usually bring relief. For cleansing purposes a soft sponge should be used instead of the ordinary toilet paper.

If the **hemorrhoid** should prolapse, they are to be immediately **replaced** within the inner sphincter and the parts bathed with a cool solution of **boric acid**; if the prolapsed masses are large, the application of a 10 per cent. **cocaine solution** and thorough inunction with an ointment containing **cocaine and adrenalin** will facilitate their return. Sitting at stool favors relaxation of the bowel, and

should be avoided, the patient standing or lying down. **Rest in the recumbent position**, with the hips elevated, for five or ten minutes after the bowels are moved, favors the emptying of the hemorrhoidal veins. If the hemorrhoids become inflamed, **rest in bed** and frequent **warm boric acid fomentations** will soothe the parts. This may, however, only be temporary, the permanent relief being postponed until pregnancy has terminated and the pressure and congestion have disappeared. (See HEMORRHOIDS, vol. iii.)

UTERINE PAIN.—Uterine pain may be due to a rigid and unyielding condition of the tissues of the organ, the pressure of contiguous viscera, emotions of various kinds, the movements and pressure of the fetus, traumatism from without, etc. The pain may be sharp or prolonged and aching, and is due to the contraction of the muscular fibers of the uterus. It may recur at frequent intervals, and if it should continue for a period of several hours it would result in the emptying of the organ.

Treatment.—This consists of **rest**, the **horizontal position**, and an occasional hypodermic of morphine (**morphine sulphate**, $\frac{1}{8}$ grain—0.008 Gm.; **atropine sulphate**, $\frac{1}{120}$ grain—0.0005 Gm.), given only when pain is severe, may be used for its relief. The pain may be so evanescent that no treatment will be required other than the avoidance of its cause, if that can be discovered.

SPURIOUS PREGNANCY.

Spurious pregnancy, or pseudocyesis, deserves consideration because the physician should always be prepared to distinguish it from true

pregnancy. Spurious pregnancy originates generally in a desire to become pregnant, which may become an intense yearning. It depends principally upon the presence of an abdominal tumor which may undergo enlargement suggestive of the gravid womb. Symptoms of true pregnancy may be present, including the "morning sickness" and the violet discoloration of the mucous membrane of the vagina, which is due to impaired or disturbed circulation the same as in uterogestation. The tumor may be uterine or extra-uterine, ectopic pregnancy being excluded. Of the extra-uterine tumors the simplest form is due to the presence of gas in the bowels. Strange as it may seem, this may persist for weeks and delude the patient completely. This "phantom tumor" is not uncommon and its sudden collapse is likely to cause the greatest surprise, if not disappointment. The other simulative form of extra-uterine tumor consists in the various types of cysts or solid growths, especially those of the ovary. These tumors sometimes grow very rapidly, this being especially true of the malignant tumors of the abdomen. In the early days of ovariectomy unmarried women were repeatedly accused of pregnancy when suffering with ovarian cysts. Not infrequently an ovarian or other form of abdominal tumor develops coincidentally with uterogestation.

Tumors of the uterus which simulate pregnancy are principally of two forms: those which are due to the presence of fluid and those which are due to the presence of gas. Rarer forms: those which are due to the so-called molar pregnancy, or hydati-

diform mole. Solid tumors (fibroids) of the uterus develop so slowly that they are seldom mistaken for pregnancy, though the contour of the fibroid uterus is often very suggestive of gestation. *Molar pregnancy* is, in reality, a myxomatous tumor due to proliferative degeneration of chorionic villi. It is formed usually in the first, but not later than the third, month of pregnancy. Beginning as a true pregnancy, the fetus dies early in its history and is absorbed. Cysts of varying size, from a small seed to a walnut, filled with a mucous fluid, are formed in great numbers and are occasionally detached.

Abortion may occur prior to the sixth month or the condition may go to term or even longer and require surgical interference. Death from hemorrhage is one of the dangers which is to be apprehended.

In hydatid tumors of the uterus, which are extremely rare, the diagnosis depends, of course, upon the actual presence of acephalocysts or their hooklets. The cystic tumors in molar pregnancy are suggestive of acephalocysts; hence the term hydatidiform mole.

When the uterus is enlarged by a collection of fluid or gas the condition is known as hydrometra (a collection of more or less watery fluid), pyometra (a collection of purulent fluid), hematometra (a collection of blood), and physometra (a collection of gas). They must not be confused with those cases in which there is disease of the decidua, the amnion, or the placenta, and in which true, and not spurious, pregnancy is present. They are all conditions in which infection is probable.

Enlargement of the uterus from the retention of menstrual fluid might also be regarded as simulative of pregnancy and is not very rare. It occurs principally in young unmarried women. In all of these cases of uterine enlargement the indication is to **empty the uterus**, and usually it will be proper to follow this procedure with **irrigation and curettage**. The latter operation must be performed with caution and discrimination, and in most cases a light **tampon** should be introduced into the organ and retained two or three days.

An actress aged 30, with 3 children, during a professional tour menstruated regularly, unaware of being pregnant until dribbling of amniotic fluid occurred just before delivery. A normal child resulted. Beckers (Bruxelles méd., Apr. 19, 1925).

CONCEALED PREGNANCY.

In this condition, true pregnancy is concealed by some other more palpable and demonstrable condition; such as a solid or fluid tumor of the pelvis and abdomen. Such tumors may exist and have been discovered prior to the pregnancy. In cystic tumors pregnancy may occur and perhaps continue to term, but the latter may not be discovered until it is far advanced. With solid tumors, especially those which involve the structure of the uterus, the resistance is greater and pregnancy is usually interrupted or at least interfered with before it has progressed very far. In some cases delivery at term becomes impossible by the ordinary channel, and an **abortion must be induced, the tumor must be removed**, or else it may be necessary to **remove the fetus through an abdominal incision**. Concealed pregnancy may,

therefore, be a most undesirable complication. Rarely pregnancy takes place under normal conditions and the situation is not suspected until a late period. The menses appear at regular intervals, the abdomen does not show the usual symmetrical enlargement, and for various reasons the woman does not realize that pregnancy is present. Of course, the only treatment which is indicated is the expectant one, the pregnancy being allowed to continue to term.

J. O. ARNOLD,
Philadelphia.

PREGNANCY AND PARTURITION (CONTINUED).

B. PARTURITION.

DISORDERS OF PARTURITION.—Neglect of a thorough examination of the patient months before the expected event occurs causes the obstetrician to be unprepared until the labor sets in, and, at times, to encounter complications which might have been avoided or checked had he undertaken prophylactic measures. Careful examination of the size and conformation of the maternal pelvis, to ascertain whether there is a disproportion between the bony structures and fetal head, is another measure which tends to reduce the mortality of both mother and fetus.

The recognizable causes of dystocia may be *maternal* or *fetal*.

MATERNAL CAUSES.—These may be subdivided into general and local predisposing factors. Any constitutional vice, whether acute or chronic, predisposes to anomalies of the expulsive forces, occasionally resulting in precipitate labor, but more often in protracted labor. Tuberculosis, organic heart disease, malaria, acute diseases—

such as pneumonia, nephritis—with the possibility of eclampsia, represent the *general* maternal causes most frequently encountered. The *local* maternal causes are of even greater importance, and consist of tumors, uterine or extra-uterine; pelvic deformities, including bony tumors, generally contracted and flat rachitic pelvis, simple flat pelvis, and irregular pelvis; spasm or rigidity of cervix or abnormalities or tumors of the same; uterine malformations, either congenital or acquired; hematoma of the genital tract; spasm, rigidity, or abnormality of the vulva or perineum; full bladder or rectum; placenta previa; uterine rupture or inversion; intrapartum and postpartum hemorrhage, and retention of the placenta and membranes.

When the uterine muscle shows feebleness in the beginning of labor and during dilatation, this condition of atony is called primary uterine inertia. It may be due either to anatomical changes in the uterine muscle or to disturbed innervation. Secondary inertia is a condition of exhaustion which, from various causes, comes on during the period of expulsion. Before rupture of the membranes, in primary inertia, there is no indication for active intervention. After rupture, if there is danger to life of the child from the discharge of liquor amnii, or the mother's life is imperiled from danger of septic infection, *dilatation* should be brought about by the metreurynter (rubber bag), and **forceps** or **version** followed by **extraction** then employed. In secondary inertia a too protracted labor is dangerous to the mother and child, and active intervention is indicated; if the head is well down in the pelvis, the **forceps** should be applied. It has recently been proposed to perform **Cesarean** section, but there is no indication for such operative procedure in inertia *per se*. In

primary inertia a combination of morphine, atropine, and strychnine often has an excellent effect when given hypodermically. After dilatation **pituitary extract** has found favor with some obstetricians. G. T. Harrison (N. Y. Med. Jour., July 19, 1913).

Obstetric shock is attributed by the writer to sudden decompression of the abdomen, an inhibiting reflex starting in the uterus, toxemia, or cardiac collapse. Generally the prognosis is not unfavorable. Manual exploration of the vagina and uterus shows that there is no hemorrhage or placental retention, that the uterine wall is intact, and that there is no important laceration of the genital tract. The patient should be kept **warm** and placed with **head low**, except in cyanosis, when the head should be raised. In case of atony of the abdominal walls, a tight **abdominal binder** should be applied and **cardiac and nervous stimulants** administered. **Oxygen** facilitates the interchanges and hematosis, but **blood transfusion** may be indicated in desperate cases. Grosse (Rev. franç. de gyn. et d'obst., Apr. 10, 1923).

Difficult labor in primiparæ over 30 years of age is merely a question of constitution. A tendency to protracted labor exists in those with hypoplastic sex organs, late menarche, slight menstruation, low fertility, or tendency to abortions. Remmelts (Zent. f. Gyn., Mar. 6, 1926).

Tumors.—*Fibroid tumor* of the uterus is so frequent as a complication of pregnancy that this is often considered of little importance. So long as the growth does not obstruct the pelvic inlet it may give rise to no trouble except possibly to predispose to hemorrhage in the third stage of labor. Fortunately, fibroids are mostly situated at the fundus and are out of harm's way; or, being pedunculated, even though encroaching so as materially to interfere with labor by occluding or narrowing

the pelvic inlet, in most cases they can be pushed up beyond the presenting part. The difficult cases are those in which large growths springing from the lower uterine wall or intraligamentous fibromata form an insurmountable barrier to delivery.

The next most frequent obstructive tumor is the *ovarian cystoma*. Peculiar as it may seem, small growths are more apt to cause dystocia than the greater ones. While patients with enormous cystomata rarely become pregnant, if this obtains, the cyst may frequently be pushed out of harm's way. The smaller varieties—dermoids, for instance—are likely to become incarcerated and so wedged in Douglas's *cul-de-sac* as to make the possibility of terminating labor by the ordinary passage practically impossible. Again, the possibility of rupture of such a tumor is not remote.

Carcinoma of the cervix is a somewhat rare complication. Early in the course of the affection the complication is not an alarming one, since the first stage of labor is rarely influenced. It is only during the ulcerative stage that the hemorrhages, sloughing, etc., make the complication a very trying one.

From a study of the cases of tumors of the ovary complicating pregnancy and labor which had occurred in 42,000 labors at the Lying-in Hospital, New York City, Lobenstine reached the following conclusions as to treatment: In pregnancy, **abdominal ovariectomy** should always be carried out as soon as the diagnosis of ovarian tumor is made. In labor, if the tumor does not descend into the pelvis during the labor, it requires no treatment at this time. If the tumor is found to lie in the pelvis at the time of labor, endeavor to push it up gently into the false pelvis. If this cannot be done and the child is alive, Lobenstine resorts to a **vaginal ovariectomy** with subsequent **delivery of the child**, or a **Cesarean section** [procedure recommended by the author].

of this article] with **ovariotomy**, or an **abdominal ovariectomy**, with delivery per **vaginam**. If, however, the tumor descends into the pelvis during labor and the child is dead, it may be possible to do a **craniotomy and extraction**. In some of these cases, however, **ovariotomy** must be first performed. If the tumor was not removed either during pregnancy or labor, it will probably give trouble in the early puerperium. Therefore, operation soon after delivery is indicated in such cases.

Pelvic Deformities.—Pelvic deformities are comparatively rare in this country. Relative pelvic contraction—*i.e.*, a pelvis of average size which is yet too small to admit of the passage of an overlarge child—however, is common enough. In truth, there is no pelvis, except one very much contracted in one or all diameters, which cannot act naturally and without assistance as the passage-way for the fetus. A pelvis can only be said to be contracted when a particular head cannot adapt itself to that particular pelvis. This cannot be measured absolutely; it can, however, be intelligently estimated. A good rule in midwifery is the following: Any head, no matter how large, which can adapt or engage itself in a pelvis, no matter how small, can safely pass through the pelvis. The chief exception is the funnel-shaped pelvis, which, in high degrees, is exceedingly rare. A pelvis with normal or supernormal measurements can be as contracted for the passage of a large unyielding head and cause the same interference, as a pelvis whose size is estimated as small or much below the normal; or, on the other hand, a very decided degree of pelvic contraction or distortion is no barrier to the passage of a sufficiently small child at term.

In Hofmeier's service there were 526 cases of delivery with narrow pelvis, including 27.9 per cent. pri-

miparas. The total fetal mortality was 10.2 per cent.; the maternal, 0.57 per cent. Premature delivery was induced in 63 cases. All women with contracted pelvises should be sent to a hospital at least on the inception of labor. The narrow pelvis cases formed 5.26 per cent. of the last 10,000 deliveries. The women were delivered by **Cesarean section** in 17.1 per cent. of the 526 cases, and by **pubiotomy** in 4 instances, but such operations have been abandoned since 1909. The degree of contraction of the pelvis averages high at this clinic (Würzburg), the conjugate diameter measuring from 5.5 to 7.5 cm. in 23.3 per cent.; from 7.6 to 8.5 cm. in 52.7 per cent., and from 8.6 to 10 cm. in 24.1 per cent. Schmitt (Zeit. f. Geburtsh. u. Gynak., Apr. 5, 1921).

The *unknown* elements in all these cases are, first, the size of the child's head and its condition, and, second, the force and vigor of the uterine action. To measure the size of the unborn fetal head, even at the present day, we must rely solely upon an estimate obtained by external means, including the adaptability of the head to its own particular passage-way. Yet the pelvimeter and pelvimetry afford a degree of information that it is not our intention to overlook. Thus, narrowing of one or more of the pelvic diameters should always make us suspicious and apprehensive as to the outcome and inspire unusual care in watching the progress of such a case. But never because of a pelvic contraction, except possibly where the history of prior difficult and dangerous labors is obtainable months before the advent of labor, should the patient be advised to elect any operation, until the size of the fetal head, as compared to the size of the maternal pelvis, is ascertainable.

The generally contracted justminor pelvis is the most frequent form and is

more apt to give rise to difficult labor than either the simple flat or the flat rachitic pelvis, because of the narrowing in all diameters and the absence of a compensatory enlargement. Where compensatory enlargement occurs in one or another of the diameters, as in a flat pelvis, nature seems to find this wider path to force the well-flexed head through, and studiously avoids the narrowest (most frequently the antero-posterior or oblique), the transverse, as a rule, being the compensatory diameter.

In primiparæ with contracted pelves, where the pelvis has sufficient capacity to permit the child's head to enter, the head, according to Walcher, is usually deep in the pelvis at the end of pregnancy. This often develops as early as 6 weeks before labor. Actual expulsion of the child is then frequently rapid. In funnel pelvis, Williams finds that moderate dystocia can often be overcome by placing the patient in an **exaggerated lithotomy** or **exaggerated Sims position**. This will increase the antero-posterior and posterior sagittal diameters by an average of 1.62 cm.

Among 1703 confinements at the Rotunda Hospital, there were 163 patients with external measurements considerably under normal. Internal pelvimetry was done only once, dependence being placed far more on application of the head to the pelvic brim, as made out under anesthesia and by noting the progress of labor, than on the actual dimensions. **Cesarean section** was done 19 times, and 1 patient was delivered by **pubiotomy**. In 16 cases treatment was by **induction of labor**, 11 times for definite pelvic contraction and 5 times for disproportionate size of the fetus. Fitzgibbon, Corbet and Falkiner (Irish Jour. of Med. Sci. Aug., 1925).

There are but 2 practical diameters of the pelvic outlet—the transverse or bischial and the posterior sagittal. To ascertain them, the patient is placed in the exaggerated lithotomy position with the hips well over the

edge of the table. The ischial tuberosities are then palpated carefully with the thumbs at the widest transverse diameter (which passes transversely across the anterior border of the anus). The measurement may be made with a special outlet pelvimeter or, more simply, with a linen or steel tape stretched against the tuberosities over the thumb ends. As for the posterior sagittal diameter, its anterior end is centrally located on the fixed transverse interischial diameter, while the posterior end is represented by the tip of the sacrum. The contracted outlet pelvis, or funnel pelvis, constitutes 44 per cent. of all the pelvic deformities in white women. The transverse diameter is 8 cm. or less, and if such a diameter is noted, it becomes important to measure the posterior sagittal, which is normally 7.5 cm. With a contracted outlet and the baby of average size, a **mesiolateral episiotomy** is indicated, when delivery is to be carried out from below. C. O. McCormick (Amer. Jour. of Obst. and Gyn., June, 1926).

Spasm or Rigidity or Other Abnormalities of the Cervix.—These are potent and frequent causes of dystocia, their tendency being to very materially prolong the first stage of labor. The spasm of the cervix may be due to reflex conditions, such as malpositions of the fetus, but a most frequent cause is a general neurotic state of the patient. The pains existing are very severe and lasting, while no material progress takes place in the cervical dilatation.

The diagnosis is positive if, on examination, the edges of the os are found very rigid, but thin, having a razor-like edge, very hot, extremely painful, and tightly hugging the head.

Rigidity of the cervix is, as a rule, the result of previous cervical lacerations or a previously existing chronic cervical endometritis, both conditions

producing more or less marked cicatrizations of the cervix.

Spasmodic rigidity of the cervix produced by **ergot**, with consecutive retention of the placenta, in a 23-year-old primipara seen by the writer. Fifty centigrams ($7\frac{1}{2}$ grains) of ergot increased the pain and was followed by expulsion of the child. As the secundines failed to appear, a second dose was administered. The second dose produced a uterine spasm so intense that the administration of chloroform was necessary before manual detachment of the adherent placenta could be effected. Even though every precaution was taken, puerperal infection developed and lasted 3 weeks. The possibility of such effects of ergot on primiparæ renders the use of forceps more desirable. B. Garriga (*Arch. de ginec., obst. y pediat.*, xxiv, 65, 1921).

Malformations of the Uterus.—Bicornate uterus and other congenital malformations, as well as acquired states of the vagina, give, as a rule, very little trouble during labor, since the patient either aborts early or, if pregnancy advances to full term, nature takes care of the malformations.

Occasionally a congenitally deformed uterus ruptures at term, but this complication is rather as much an accident as though it occurred in a normal uterus.

Pathologically deflected uteri, the result of a prior existing pelvic peritonitis, are seldom causes of dystocia at term. If the pathological condition is extreme, these patients seldom become pregnant normally, and are more likely to be the victims of an ectopic pregnancy. If the adhesions which bind the uterus in a false position are not too old, the growing uterus will stretch them sufficiently to allow that organ to assume its normal position. If not, abortion is the usual result.

[In instances of this nature, the woman being exceedingly anxious for offspring, the possibility of avoiding abortion by operative separation of the adhesions is justifiable in view of the slight risk.]

Tumors of the lower genital tract, including hematoma, are rare complications, and yet when they do occur may produce very alarming conditions.

Spasm, Rigidity, or Other Abnormality of the Vulva or Perineum.—

Predisposition to these conditions attends those that are too young, in whom the parts are undeveloped and unyielding, or, on the other hand, those in whom spastic contractions of the sphincter ani exist. They are also apt to occur in women who conceive late in life, whose genital tract is tense and resisting. In another class, in which, occasionally, previous lacerations give rise to firm cicatrices, an almost absolute barrier is offered, which can only be overcome by radical measures such as episiotomy.

Full Bladder and Rectum.—These conditions constitute a most prolific cause of difficult and prolonged labors. One would suppose that a normal bladder would functionate spontaneously, but this is not always the case. By disturbing the axial relation between fetus and pelvis, owing to displacement of the uterus by an overdistended viscus, grave and marked symptoms may arise. These, however, can be readily arrested as soon as the cause is discovered. With equal force can an overdistended colon and clogged rectum produce the same disturbance.

Posture of the Patient After Labor.

—For a few hours after labor, a patient should be kept in the recumbent horizontal position. After recovering from any exhaustion, she should be placed in

a modified Fowler position, the shoulders several inches higher than the pelvis, allowing her to turn from side to side, and encouraging her to turn upon the face in the prone position. Thus is drainage of the birth-canal promoted. The author believes that every puerpera would be the better for remaining absolutely in bed for two weeks. Within this time, aided by good **hygiene, general massage, occasional assumption of the knee-chest position** toward the end, and the administration of **strychnine** and **ergot**, the lochia usually will have ceased and involution of the uterus and other structures will have progressed well. With the present notions of the laity, however, it is usually impracticable to keep the patient in bed more than ten days. She is then soon excessively on her feet, often with resulting prolonged subinvolution, metrorrhagia, and uterine displacements.

Retention of Placenta and Membranes, Intrapartum or Postpartum Hemorrhage, Inversion of the Uterus, and Rupture of the Uterus are accidents or complications of labor that should seldom occur, and which are usually due to mismanagement or carelessness on the part of the obstetrician. Proper skill and vigilance will usually avoid them.

Fragments of placenta are often retained in the uterine cavity for a considerable time. They are sometimes considered benign tumors, capable of assuming malignant characteristics. The writers believe that a change from placental tissue to chorionic epithelioma is altogether exceptional, and so far has not been proved. A placental polyp should not be considered a benign tumor, for it does not grow by the proliferation of its own elements which extend into adjacent tissue as tumors usually do. The best concep-

tion of the retained placenta is that it is a sort of graft which may continue to survive occasionally for a long time through the maternal circulation, and which in the end is either absorbed or eliminated. The accumulation and organization of clotted blood produces the apparent increase in the size of this region, and this is comparable to a thrombosis which grows along the blood-vessel. These prolonged retentions of placental tissue constitute residue with a precarious life, having only a transient existence in the organ harboring them. Lencane and Promsy (*Ann. de gynec. et d'obstét.*, Oct., 1919).

Retention of the placenta and membranes, as a whole, is often more apparent than real. With proper patience, in the absence of undue hemorrhage, simple manipulation will very rarely fail in their final expulsion. Coincident with fetal expulsion, a hand on the abdominal wall should follow the fundus of the uterus down to see that there is moderate contraction of the organ. The uterus should thus be guarded, to note that it is not relaxed, this usually being overcome by moderate compression. On the other hand, no undue manipulation should be used, lest the placenta be separated before the tired muscle has regained its tone and time has elapsed for thrombi to form in the uterine sinuses. Preferably a half-hour should elapse before placental separation. Meanwhile, perhaps, separation has occurred, indicated by the hardening of the uterine body and the moderate "rising up" or anteversion of the organ. On such indication Credé's method of grasping the uterus with the whole hand—the thumb posterior, the fingers anterior—and making firm compression and pressure downwards may properly be used to assist the natural forces of the patient in expelling the

after-birth from the cervix and vagina. Haste should be made slowly at this stage, receiving the placenta in the hand and gently revolving it, and twisting the after-coming membranes to avoid tearing them and leaving portions behind.

If, after half an hour, there is no sign of placental separation, moderate Credé manipulation will very generally stimulate the uterus to the necessary contraction. If at first not successful, the procedure should be repeated at intervals for at least two hours. Meanwhile, a hypodermic injection of a dose of **pituitary body** may aid materially. Ergot should never be given at this stage. Its injudicious use may have been the active cause of locking up the after-birth.

Not a few good obstetricians would pursue the expectant plan for many hours rather than introduce the hand into the uterus for manual removal of the secundines. The author believes, however, that if, after two hours, the means outlined above are unsuccessful, it is for the best interest of the patient gently to extract the after-birth with the carefully sterilized and disinfected, gloved hand in the uterus. This should not be undertaken lightly, and the grave danger of septic infection should be avoided with the utmost care as to surgical cleanliness. The whole of the after-birth should be secured in the palm of the hand before removal of the latter, so that there may be no necessity for its reintroduction. No other intra-uterine manipulation is such a menace as regards infection.

The writer injected **salt solution** into the placenta through the umbilical vein in 30 hospital cases. The placenta was then expelled spontaneously in 3 to 5 minutes. The cannula should have a circumference of 1.5 cm. and a groove to prevent slipping of the cord when attached to it. Fifteen or

20 Gm. ($3\frac{3}{4}$ or 5 drams) of salt are added to 1500 c.c. (3 pints) of sterilized **hot water** (50° to 60° C.). Swelling of the arteries proves that the injection has been successful. When 200 c.c. of solution has entered, placental detachment begins. To prevent clotting, 2 per cent. of **sodium nitrate** is added to the solution. Sklayounos (Surg., Gyn. and Obst., Feb., 1920).

When light pressure is made on the fundus of the uterus with the fingers, the clamped umbilical cord stiffens if the placenta is still attached; if it has already separated, no effect on the cord is produced. This "cord sign" shows the exact moment when Credé's method is indicated. Hegewald (Münch. med. Woch., May 5, 1922).

To reduce the risk of infection in manual extraction of the placenta, the writer, after washing his hands, moistens them with 1:4000 or 1:5000 **adrenalin chloride** solution, prepared by pouring the contents of 1 or 2 1-c.c. ampoules of 1:1000 adrenalin into 4 or 8 c.c. of sterile water. When the hand enters the uterine cavity immediate contraction of the vessels touched by it results. Joachimovits (Wien. klin. Woch., May 8, 1924).

Postpartum hemorrhage, so-called, is often intrapartum, beginning before the completion of the third stage, frequently soon following the third stage, rarely beginning an hour or more subsequent to the completion of labor. The proper management of the third stage, as indicated above, will very generally secure against such a serious result. In a maternity service with which the author was connected for years, it was a routine custom to have a nurse, who was well trained in the technique, to guard the uterus with a hand on the abdomen for the first hour of the puerperium. On any tendency to relaxation of the uterus it was kneaded and grasped firmly. No serious hemorrhage ever occurred. I would that such could be the routine treatment of every case.

We should be on special guard in certain cases of abnormal labor—prolonged exhausting labor, precipitate labor, cases of undue distention, placenta previa, or neoplasms complicating. Withal, much depends upon the skillful management of the third stage. Unfortunately, the placenta sometimes becomes detached, either partially or completely, too soon following fetal expulsion, hemorrhage ensuing. If, upon gentle manipulation, the bleeding does not cease, it is imperative to proceed and promptly to secure placental expulsion and firm uterine contraction. An empty uterus firmly contracted cannot bleed excessively from the placental site. Severe hemorrhage under such conditions can usually be located in tears of the genital outlet or cervix.

Routine administration of **ergot** with **strychnine** immediately following placental expulsion is an excellent prophylactic. A preparation of ergot for hypodermic use should always be available. A good dose of the **pituitary** preparations, in addition, is excellent. Usually measures outside the birth tract, such as indicated, having excluded cervical and vulvo-vaginal tears, will successfully prevent or control postpartum hemorrhage. A **vaginal douche** of sterile fluid at a temperature of 115°-120° F. will often stimulate uterine contraction. If not successful, an **intrauterine douche** will likely be effective. In persistent or alarmingly severe cases, firm **packing of the uterus** with sterile gauze is the only means of assured success. The author has several times been very successful in such cases with **Breisky's method of bimanual compression**, with the fingers of one hand pressing through the abdominal wall upon the posterior surface of the uterus, two fingers of

the other hand introduced into the anterior vaginal fornix pressing against the anterior uterine wall. The uterus is thus firmly grasped, compressed and somewhat anteflexed. The aorta may be compressed at the same time.

Placenta Previa and Abruptio Placentæ.—Two placental conditions not infrequently resulting in the gravest intrapartum hemorrhage are *placenta previa*, low attachment of the placenta, and *abruptio placentæ*, premature detachment of a normally situated placenta. The problem, alike in both, is to minimize the hemorrhage until the uterus is emptied, to combat postpartum hemorrhage, and to relieve the anemia.

Placenta previa is usually characterized by genital bleeding in the latter months of pregnancy, the hemorrhage occurring without apparent cause and without painful uterine contractions. The positive diagnosis is made only by palpating a portion of the placenta through the cervical canal. Such a diagnosis made, the indication is to empty the uterus without delay. "There is no expectant plan of treatment." The only exception permissible is that with the child near viability, the patient bleeding slightly, having her in bed in a properly equipped hospital, we may occasionally await the viable period before inducing labor.

Labor having been induced by an approved method or the process having begun spontaneously, the obstetrician should be in constant attendance. Skill and facilities should be at hand to meet any emergency. If the case be one of lateral or marginal placental attachment, the bleeding may be but a little more free than that of normal labor, and it may be sufficient that the case be attended as one of normal spontaneous delivery, meanwhile watching with

all vigilance, ready to act on a moment's warning. Early **puncture of the membranes**, securing pressure of the head on the placental site, may serve to lessen the hemorrhage.

Cases of *complete (central)* or even of *partial* placenta previa sometimes are best treated by most radical means. With the cervix tightly closed and firm, the bleeding frank, and the child in good condition near term, abdominal **Cesarean section** should be the elective procedure. Such a condition would rarely exist except in a primipara. With a soft dilating cervix and efficient pains, firm **intracervical** and **vaginal packing**, removed in twelve hours or less, may minimize the bleeding while cervical dilatation progresses. Meanwhile, a very firm abdominal **binder** (Spanish windlass variety recommended) should supply counterpressure. On removal of the gauze, if no active bleeding appears, watchful expectancy may be the plan. Renewal of the packing may be indicated. By such procedure, the attendant may be rewarded by an engaged fetal head coming through a dilated cervix. The first stage of labor thus having been successfully completed, it is usually to the interest of the child, and not detrimental to the maternal interests, to deliver promptly with forceps.

Central and *partial* placenta previas are best treated by low abdominal **Cesarean section**, whether the baby is viable or non-viable, living or dead. *Marginal* previa is best treated by Voorhees **bag induction**. Moribund or very sick patients should be **rested**, and bleeding controlled by necessary methods, including **tight cervical and vaginal pack** and **pressure over and above the fundus**; **transfusion** and operation should be done on pulse and pulse-pressure reaction, and then **retransfusion** done. It should always be the

effort to ascertain how much blood has been lost and to replace that amount. **Hysterectomy** following section should be practiced frequently, on the following grounds: Risk of sepsis from previous history, persistent bleeding following the section, and number of dependent children. If a woman has several children, and hysterectomy seems to improve her chances, it should be done. F. S. Kellogg (Amer. Jour. of Obst. and Gyn., Feb., 1926).

Two other means of assistance are always to be kept in mind, and should be available resources, namely, **podalic version** and the **metreurynter**. In using the former, the life of the child must be practically ignored, the thighs and buttocks of the fetus being used as a tampon to staunch the hemorrhage. In the *central* variety, this method is often imperative, the operator having to break through the placenta to secure a foot. Such manipulation, done early, must be by the **Braxton-Hicks method**. With the cervix dilated sufficiently to admit two fingers, the membranes are punctured or the placenta bored through. The fingers gently push the head upwards and to one side, the external hand pushing down the breech, then a foot, in the direction of the inside fingers. Complete relaxation of the patient, perhaps by brief anesthesia, is essential to the maneuver. A foot having been grasped, it is carefully drawn down into the vagina, the external hand pushing up the fetal head. Version having been completed, moderate traction upon the leg of the fetus will effectively tampon the cervix and lower uterine segment. There should now be no fear of immediate undue loss of blood.

In the 257 cases at the Vienna clinic in the last 9 years (24,678 deliveries), the rule has been to apply **combined bipolar version** when the condition

calls for immediate hemostasis, regardless of whether the child is viable or not. Delivery followed within 20 minutes in the 43 cases in which this was done with the os dilated for 2 fingers or more. The mortality of the probably viable children was 38 per cent., and 6.9 per cent. of the mothers succumbed, from earlier loss of blood. The combined **Braxton-Hicks version** was applied in 41 per cent. of all the placenta previa cases, and the maternal mortality was 3.8 per cent. The **inflatable bag** was used in 35 cases, the cervix admitting only the finger, and 52.4 per cent. of the children were born alive and none of the women died. Hliess (Monats. f. Geb. u. Gynäk., Mar., 1921).

In his last 591 cases of placenta previa, the writer lost 70 mothers, a mortality of 12.1 per cent., with a still-birth mortality of about 42 per cent. The preference in treatment was given to **gauze packing**, followed in most instances by an **internal podalic version**, this being done in 354 cases. There were 34 abdominal **Cesarean sections**, 2 extraperitoneal sections, 3 vaginal **hysterotomies**, 20 **Braxton-Hicks operations**, 43 **breech extractions** and 22 **craniotomies** on dead children, the rest being made up of forceps and normal deliveries. McPherson (Amer. Jour. of Obst. and Gyn., Apr., 1924).

The mistake should not be made of now hastening delivery by breech extraction. Wait until the patient partly reacts, meanwhile securing complete dilatation of the cervix. Observance of the latter may be the means of saving the life of the mother.

The **metreurynter** or **hydrostatic bag** is a valuable help in many cases. Every obstetrician should be provided with a set in graded sizes (Voorhees type), conical in shape, flat top. For general technique, see INDUCTION OF LABOR, page 649. One special point in technique must be carefully observed when the bag is used in placenta previa,

namely, that the membranes must be ruptured and the bag be introduced inside the amniotic sac above the placenta, so that the pressure exerted by it is upon the placenta from above downward. During the interim between the uterine pains, moderate traction, not to exceed one or two pounds, should be made on the tube connected to the bag—no traction during the pains. In this way, the hydrostatic bag simulates the natural dilatation by the amniotic sac, and by constant firm pressure acts as a tampon to control bleeding. By this method, the chances of saving the child are increased. When a bag sufficient in size to accomplish complete or almost complete dilatation passes from the cervix, it is of the utmost importance to be prepared to act promptly. Sometimes the head enters the cervix and pelvis promptly as the bag passes, and in such cases the attendant may, with greatest advantage to all, await nature's lead. When the head passes through the cervix, it is best to deliver promptly with **forceps**. If the head cannot be brought down into the cervix, prompt **podalic version** and subsequent **breech extraction** are the procedures.

In over 2000 cases of placenta previa collected from various sources, the maternal mortality was 7.7 per cent., with a high morbidity; the fetal mortality was 61.5 per cent.

The writer advocates the extra-ovular introduction of the **elastic bag** for the arrest of hemorrhage. The patient's condition must be carefully watched. If the bleeding reappears an immediate examination is necessary, because such bleeding usually indicates the expulsion of the bag. In many instances of *incomplete* placenta previa rupture of the membranes occurs spontaneously about this time and the presenting part en-

gages and descends. Bleeding may occur immediately after the delivery of the child. It is best to conserve the patient's strength as much as possible by immediate expression of the placenta followed by the injection of 1 or 2 c.cm. of **puitrin** or the administration of **ergot** by mouth if prompt uterine contraction does not result. C. W. Kosmak (Bull. Lying-in Hosp. N. Y., xii, 51, 1920).

Accidental hemorrhage (abruptio placentæ) or premature detachment of a normally situated placenta may be due to a fall, blow, kick, or other traumatism, or may occur independently of any such experience. The most important predisposing cause is decidual disease. Many cases are so mild as to escape notice, but severe types are grave and most difficult to deal with.

The diagnosis is based upon the symptoms and signs of acute abdominal pain on one side, sudden in onset, tense abdomen, absence of fetal heart sounds, generally external hemorrhage, with general symptoms of increasing anemia and shock.

The best treatment is that which empties the uterus in the quickest way with least danger to the mother, meantime controlling the hemorrhage, and afterwards relieving the anemia. The condition of the cervix guides in the method chosen. If dilated or readily dilatable manually, **forceps** or **version** may terminate the labor promptly. If the cervix is tightly closed, **abdominal Cesarean section** may be the wiser course.

The cervix being only slightly dilated and practically effaced, probably the best course is **puncture of the membranes**, introduction of a **hydrostatic bag**, **packing the vagina** very firmly, applying an abdominal **binder** with as much compression as the patient

will bear, and administration of **ergot** or **puitrin**, one or both, to stimulate uterine contraction. When dilatation is sufficient or can be completed manually (the cervix may have to be incised), the delivery can be done by forceps or version and extraction. If the hydrostatic bag is not used, the membranes should not be punctured early.

Inversion of the uterus, incomplete or complete, is a rare complication of labor and can usually be ascribed to mismanagement of the third stage. An abnormally short cord may predispose, or undue traction on the cord by the attendant or by delivery of the child when the patient is on her feet may cause it. The author has observed only one case. When anesthetizing for an obstetrician he noted that the Credé method was attempted, but perhaps unskillfully employed. Instead of the uterus being grasped in the hand, pressure was made with the fingers on the fundus, beginning an inversion, which uterine contraction quickly completed.

The treatment is prompt manual **reposition** of the uterus by taxis, after removal of the placenta. The fist of the operator should remain in the uterus until uterine contraction is in evidence and bleeding has largely ceased. If the latter is not readily secured, the uterus should be firmly packed.

Rupture of the uterus rarely occurs in good obstetric hands. It is chiefly due to obstructed labors. Even in cases of symptoms of threatened rupture this catastrophe may usually be averted by good judgment and prompt, skillful action.

The most frequent causes are disproportion between the fetus and pelvis, and abnormal presentations or positions, *e.g.*, shoulder and brow presentations. Tumors obstructing the pelvis, a dis-

eased uterine wall, or one the site of a previous Cesarean section, may predispose. The giving of ergot, intra-uterine manipulation, for example in version, and placenta previa are sometimes evident causes. A threatened rupture should usually have been anticipated and prevented. Probable disproportionate size of fetus and pelvis should have been determined during pregnancy and should have been anticipated by, perhaps, induction of labor before disproportion was actually reached; or, having given the test of labor at term, by substituting Cesarean section for a prolonged obstructed labor.

A restless, anxious patient complaining of intense pain, with accelerated pulse, strong—sometimes tetanic—uterine contractions, the upper segment thickened so as to show a palpable groove across the abdomen below the contraction ring—these signs should be sufficient to warn of impending danger of rupture. Immediate measures must relieve the condition. Relaxation should at once be secured by **ether** anesthesia and such procedures used as the case demands. Any internal manipulation must be done with the greatest caution. The child in good condition and the pelvis markedly contracted, **Cesarean section** should be done. There being no great disproportion and no obstruction by the soft parts that cannot be readily remedied, **forceps delivery** may be the choice. Nice judgment and best skill may be necessary in correcting malpresentations or positions. In shoulder presentation, the child in good condition, **version** may possibly be done under profound anesthesia. The child being dead, **embryotomy**, including **craniotomy**, are the means of relief.

The diagnosis of actual rupture is usually made by the symptoms and

signs of sudden excruciating pain, followed by collapse. Uterine contractions cease or are weak, there is an asymmetrical tumor of the abdomen, with perhaps tenderness. There is usually external bleeding, and internal examination perhaps reveals the fact that the presenting part has receded. The fingers may feel the uterine rent.

In such cases **delivery per vaginam**, if the rupture is not complete, may be practicable, uterine packing following. In complete rupture, and indeed in many other cases, the interests of the mother will best be conserved by **laparotomy**. In this procedure, the child having been removed, the surgical judgment of the operator must determine whether to **suture the uterus** or to perform **hysterectomy**.

In all cases of abnormal labor, special precautions must be taken against postpartum hemorrhage. (See Postpartum Hemorrhage.) In cases of excessive blood loss, all the approved means for relieving acute anemia should be availed of. This should include, in extreme cases, **blood transfusion**.

FETAL CAUSES.—The fact that the fetus causes dystocia either by being oversized or by presenting itself in a vicious position simplifies the lines of treatment very materially. A large, unyielding head attempting to pass through what is usually considered a normal pelvis produces such disproportion between the head and pelvis that the latter must be considered contracted so far as that particular head is concerned. If the head is unusually large or refuses to mold, we may be confronted with a condition which would warrant us in seriously considering a major operation in order to effect delivery. This same statement holds

equally good in an unrecognized vicious position of the fetus. The chief fetal causes of dystocia may be enumerated as follows: Too large a fetus, including partus serotinus; prematurity; multiple pregnancy; monsters; hydramnios or oligohydramnios; adhesion of membrane or decidua; thick membranes; malposition; malpresentation.

Abnormally Large or Small Fetus.

—A fetus which is oversized has a decided influence in causing dystocia. The subject has been referred to elsewhere in this article. True partus serotinus is rare, but it undoubtedly does occasionally occur. Here the pregnancy is prolonged, the woman even carrying the fetus as long as eleven months. This is verified by the unusual size of the child, the long hair, and the long, firm finger-nails. Too small a fetus or one that is premature gives rise to complications, because it has a tendency to assume a vicious position.

The writer recommends the following measures to minimize the traumatism: 1. The **elimination of fats and carbohydrates from the diet** of the mother during the **last 6 weeks** of pregnancy to retard the full or overdevelopment of the fetus. In such cases the child will be from 1 to 2 pounds lighter and none the worse for it. 2. The **induction of labor 10 or 12 days before term** before much disproportion has been reached. 3. In cases of contracted pelvis and small fetal head the application of the **test of labor** followed by **instrumental delivery** if necessary. 4. The **test of labor at term** and emergency **Cesarean section** without instrumental interference when in doubt, and elective Cesarean section when there is no doubt, as to the possibility of delivery by the natural route. He holds, moreover, that the greater number of cranial injuries occur from the application of forceps to the head in a faulty position. When there is

doubt he advises that the position of the head be ascertained by the introduction of the gloved hand. Protracted labor does greater harm to the child in transit than the use of the forceps properly applied. J. C. Applegate (N. Y. Med. Jour., cix, 626, 1919).

Multiple Pregnancy.—Multiple pregnancy, because of overdistention of the uterus or, again, because malpositions in this case are the rule, is a frequent source of difficult labors.

Monsters.—Hydrocephalus, joined twins, congenital tumor, anacephalic monsters, either because of their size or their tendency to present pathologically, are nearly always the cause of difficult labors.

Hydramnios.—Hydramnios, by overdistention, acts similarly to multiple pregnancy, while the opposite condition, oligohydramnios, is frequently associated with grave malformations of the fetus. This, with the absence of the water-wedge to dilate the os, usually produces a very prolonged first stage.

Adhesions of the membranes or persistence of the decidua in the neighborhood of the internal os or very thick and resisting membranes, the result of a chronic deciduitis, is a causal factor which can produce as much trouble as an occlusion of the external os. Indeed, it often simulates the latter condition. Unless recognized and measures be taken to overcome the occlusion, it is not impossible for a uterine rupture to occur.

Malposition and Malpresentation.—Under this subdivision we have the most prolific causes of dystocia. The great danger lies chiefly in the fact that when a malposition rather than a malpresentation occurs it is sel-

dom recognized. We refer especially to occipitoposterior positions, than which no more troublesome complication arises. We emphasize the fact that a malposition of a normal presentation is possible. Similiar malpositions would include chin-posterior cases. The fault in the non-recognition of these cases always rests with the physician. Most examinations are perfunctory; the attendant rests satisfied so long as he feels the round, bony head, whether engaged or non-engaged.

Characteristic of all vicious positions and presentations are early rupture of membranes, slight nagging pains, and slow or absent engagement of the head. Non-engagement of the head generally means either a malpresentation or malposition or a relative or absolute pelvic contraction; in short, a pathological condition. The obstetrician might possibly err in failing to find a pelvic distortion or contraction; he must never fail, however, to clear up a malposition or malpresentation. If this is not possible by the ordinary means, he must insist upon the introduction of the whole gloved hand into the uterus to clear up the condition, although this requires anesthesia. It is evident, reasoning from practical experience, that, since highly contracted pelvis in this country are comparatively rare, the most frequent causes of dystocia can be ascribed to malpositions and malpresentations. Early recognition and timely interference as the case demands, operating then and there only when the indications present, are the secret of absolute success.

The profession recognizes that the common and most favorable conditions are universal flexion of the fetus, the

normal attitude; the head lowest in the birth-canal, and as a result of flexion of the head, in *vertex presentation*. The latter condition brings the two fontanelles and the sagittal suture as anatomic landmarks in internal examination, within the circumference of the birth-canal. Approximately 95 per cent. of all cases are in this relation. Moderate deflexion or extension of the head causes the unfavorable *brow presentation*, and complete deflexion or extension of the head, *face presentation*. The latter occurs once in some two or three hundred cases; persistence of the former, less often. The other malpresentations are *shoulder* or attempted cross-birth, and *breech*, these being self-explanatory. The latter constitute about 4 per cent. of all labors; the former a fraction of 1 per cent.

The vertex presenting, most authorities recognize four, some six, different relations to the pelvic circumference. The occiput of the fetal head being the point of direction, the sagittal suture representing the arrow, the small fontanelle, as the tip of the arrow, may be considered the index. The six positions of vertex presentation are therefore, left occipitoanterior, left occipitotransverse, left occipitoposterior, right occipitoanterior, right occipitotransverse, and right occipitoposterior. As the convex dorsal surface of the fetus best fits the ventral maternal tissues, we have the anterior positions much more frequently than the posterior. The right occipitoposterior position is, however, quite common. Whatever, in the engagement and descent of the head, may be the relation of the occiput, it is generally agreed that, in the normal mechanism of labor, the latter should have, previous to expulsion of the head, rotated to the symphysis pubis. This

rotation failing, the spontaneous termination of labor rarely occurs.

Rotation is dependent chiefly upon three factors, *viz.*: good flexion, good expulsive forces, and a good pelvic floor. This step in the mechanism normally occurs only after the latter is reached. *Primary occipitoposterior position*, especially on the right, as has been stated, quite frequently occurs, yet a large proportion of these, perhaps four-fifths of them, rotate spontaneously, after a prolonged labor, with the occiput directly anterior. Therefore, a policy of intelligent watchful expectancy is advocated in cases that seem to be progressing favorably. If the occiput remains posterior, failing to rotate, it is called *persistent occipitoposterior*. Failure is frequent in diagnosing occipitoposterior position. If in doubt, especially if the course of labor is not satisfactory, the whole gloved hand (not hesitating to use general anesthesia) should be introduced to palpate the fetal head. The location of the posterior or small fontanelle at the back of the pelvis will establish the diagnosis. Palpating the posterior ear the writer has often found the surest aid. At the same time manual aid may be given. During a pain the occiput may be drawn slightly forward or the sinciput be pushed backward. Flexion may profitably be increased by pushing the sinciput upward, or with the whole hand drawing the occiput downward. Coincidentally using approved measures for stimulating the expulsive forces, the mechanism may progress and the case terminate spontaneously as in normal labor. If after these simple expedients the occiput persists posteriorly, the preferable procedure is manual rotation done under ether, sufficient to secure thorough relaxation.

In *right occipitoposterior position*, the patient in lithotomy posture, the operator, with the left hand in the birth-canal, grasps with the whole hand the fetal occiput, gradually rotating the head from right to left. At the same time external manipulation must be done by the operator, and preferably an assistant, to rotate the trunk of the child in the same direction. The aim is to secure complete rotation of the occiput to the front. If rotation beyond the transverse is once secured, the head may be held, awaiting expulsive forces, or the forceps may properly be used to terminate the case.

It must not be forgotten that many good operators have not infrequently applied forceps and delivered with the occiput directed toward the sacrum. This is usually practicable, though often, especially in primiparæ, it is a difficult delivery, resulting in severe laceration of the perineum. Episiotomy would generally be indicated.

In *face presentation* we have a condition that often, particularly in multiparæ, ends spontaneously; hence the expectant plan is suitable under favorable progress of the case. We have the positions corresponding to those of vertex presentation. The chin is the point of direction; rotation finally brings it to the symphysis. This is imperative for delivery through the pelvis, because a *persistent mento-posterior* results almost inevitably in obstructed labor with fetal impaction and death. The cue in this presentation is to use means to accomplish anterior rotation of the chin. Secure good expulsive forces, increase manually the extension of the head, draw the chin forward, or push the forehead backward, or, with the whole hand, rotate the face and the trunk, aiding by external manipulation.

The forceps may always properly be applied with the chin occupying the anterior position; never when the chin is posterior.

Theoretically and often practically, the procedure of choice in face presentation, by means of combined internal and external manipulation, is flexion of the head, rendering the case one of vertex presentation. In mento-anterior cases the objection is that the occipito-posterior results from such maneuver. In mento-anterior cases, therefore, the obstetrician must use his judgment whether to allow the case to proceed as a face presentation, convert it into an occipito-posterior relation, which is often troublesome, or to do a version and breech extraction, cervical dilatation, pelvic size, and other essential conditions favoring the latter.

In *brow presentation* we have a variety of cephalic presentation which may be said to be transitional between the complete flexion of vertex and the complete extension of face presentation. Not infrequently it is a temporary relation, often spontaneously being converted into one of the two latter presentations. By vaginal examination the fingers may palpate the orbital ridges and the small fontanelle and, intervening, the large fontanelle and sagittal and frontal sutures. Brow presentation brings into relation to the birth-canal such large circumferences of the fetal head as to make its passage commonly impracticable. Therefore, the watchword of treatment, as soon as diagnosed, is to convert the case, by complete flexion of the head, using combined internal and external means, into a vertex presentation. Failing in the latter, version may probably be the next best procedure. Attempted delivery with forceps persisted in, in a true brow presentation,

will generally prove disastrous to mother and child.

Pelvic, commonly called *breech presentation*, the lower extremity of the fetal trunk being in advance in the birth-canal, is not necessarily an unfavorable condition. The prognosis is not quite so good as vertex presentation for the mother, especially in primiparæ, and there is a considerably higher mortality and morbidity for the child. Occasionally, external cephalic version in the later months of pregnancy can readily be done and should always be considered. If, however, as is usually the case, the condition persists, here again watchful expectancy is at first to be pursued. The membranes, if possible, as in all cases, should be preserved up to complete dilatation of the cervix, and the patient's strength conserved. Not infrequently, by keeping hands out of the birth-canal and off the fetus, the attendant will be rewarded by spontaneous delivery. Pressure from above at the height of uterine contraction, with the hands placed broadly over the fundus of the uterus, may be of material help. Often, nevertheless, there is an indication, because of threatened maternal exhaustion or asphyxiation of the fetus, actively to assist by traction from below. This probably will necessitate the procedure called **breech extraction**.

In the latter procedure, traction is first made either with fingers hooked in the groin of the fetus or by grasping an extended lower extremity—one or both extremities. In case of a narrow rigid outlet of the genital canal, time should previously have been taken for manual dilatation and stretching of the parts. As the umbilicus of the child appears at the outlet, the cord should gently be drawn down and placed in

the posterior part of the maternal pelvis, where it will be less apt to be subjected to pressure. As the fetal trunk appears, a warm sterile towel, wrung out of hot water, should be wrapped about the child to prevent premature efforts at breathing. Generally the arms will have extended alongside the head and must now be delivered. As to whether the anterior or posterior arm is first delivered, practice differs according to the operator. In any case, the trunk of the child should be turned as far as practicable in the direction opposite to the arm chosen, either forward or backward. In this way the scapula and shoulder of the arm selected will be made to appear at the outlet. The operator passes the fingers over the dorsal surface of the shoulder along the upper arm anteriorly, until, if possible, the bend at the elbow is reached. The extremity, with little danger of fracture, may then be swept downward and inward over the anterior fetal chest-wall and be delivered. The other extremity is delivered in like manner.

To deliver the head, the following maneuver usually succeeds best: The child has been brought to such a relation that its occiput lies directly back of the symphysis. The forearm of the operator supports the trunk of the fetus, which lies astride his arm. A finger of this hand is passed into the mouth of the child, with which gentle traction is made upon the lower jaw to help maintain flexion of the head. With the fingers of the other hand traction is made upon the shoulders. Simultaneously an assistant should make broad suprapubic pressure upon the fetal head. At the moment of delivery of the head, the body of the child should be raised well up over the mother's abdomen. The chin, mouth,

nose, sinciput and occiput sweep successively over the perineum. As the mouth appears, the mucus being well cleared out, delay may be well made at this point for further dilatation, perhaps thus avoiding serious perineal laceration.

In *shoulder presentation* we have a condition always imperatively demanding artificial help. For birth by the natural route, some method of version must render it either a head or breech presentation. The condition most often occurs in multiparæ as a result of relaxation of the soft tissues. If it occurs in a primipara, be suspicious of fetal and pelvic disproportion and investigate the case most carefully. If the latter is excluded, external version may properly be done and frequently with the greatest ease. This should be done in the latter weeks of pregnancy. In version, cephalic presentation should be sought. If not accomplished, breech presentation should be accomplished if possible. If, after version, the presenting part can be made to engage, recurrence of the malpresentation will likely be avoided. The patient should be examined every few days, previous to parturition, making the correction over and over, if need be. An abdominal binder may help to maintain the corrected relation. If there has been a failure to correct the condition previous to parturition, some form of version should be employed as early in labor as conditions allow. External version, a very simple and safe procedure, may now succeed; if not, the combined method; or, the membranes having been kept intact, the cervix dilated, internal podalic version followed by breech extraction is often the best treatment.

The author has done, during preg-

nancy, in a considerable number of these cases, external cephalic version with the greatest ease and simplicity, and has usually been able to bring them to an active normal parturition, with vertex presentation.

Such cases, when neglected, are melancholy and fatal to the fetus and often to the mother.

TREATMENT.—Prophylactic Measures.—We must presuppose that the **pregnant woman** has been very **carefully examined** from a physical standpoint and every constitutional abnormality noted, and that any disease of an organic nature discovered has been so treated as to avoid complicating factors. It is assumed that every means has been utilized to place the patient in the best possible condition to help her safely to pass through the trying times of pregnancy and labor. To fail in **methodically examining the urine** and in obtaining a careful estimate of the excretion of urea in twenty-four hours might prove a fatal dereliction. The urinalysis should be repeated every two weeks or oftener if any pathologic condition is shown in the examination. The presence of albumin is a danger signal; on the other hand, patients sometimes die of eclampsia without the faintest trace of albumin in the urine. It is the toxins of uncertain nature that kill, not the albumin. *It is when the amount of urea diminishes that the obstetrician should look out for storm, even if no albumin be present.*

Another important index is the **blood-pressure**, which should be **taken routinely** as the patient visits the physician's office at stated frequent intervals. A systolic pressure of 130 to 135 mm. is suggestive of a mild toxemia and should put the physician

upon his guard, while a systolic pressure of 150 mm. should lead him to employ active measures to combat a more or less severe toxemia. This sign, especially if in conjunction with a low daily output of urinary solids and the presence of albumin, should be considered ominous of an impending storm.

Other signs of toxemia should be kept in mind, such as nervous irritability, insomnia, headache (frontal), ringing in the ears, flashes of light or dark specks before the eyes, epigastric pain, disturbances of digestion, swelling of the feet or puffiness of the face. These signs, all or a few of them, should lead the alert obstetrician to an appreciation of a toxemia of a *præclamptic* degree and should impel him, without delay, to put the patient to bed upon a milk and water diet, and very actively to stimulate all the emunctories. Failing to relieve the condition, the artificial termination of pregnancy is to be seriously considered.

It sometimes happens that a woman will go from one pregnancy to another, always losing the child either artificially by instrumentation or from the results of a prolonged labor, in whom, while the pelvis is normal, the children are all very large. This constitutes a pelvis which is relatively contracted.

Curative Treatment.—Given a case of dystocia due to *primary inertia*, what is the course to be pursued? So long as the membranes remain intact and the general condition of the mother and child remains good, patience will probably be rewarded by a final favorable progress. The heart action of both mother and child serve as a guide. If the mother is fed,

well, secures sufficient rest, and the bodily functions are performed properly, no active treatment is usually indicated. If the pains are nagging to wear the patient out, **bromide or chloral**, one or a combination, or other hypnotic is indicated to secure sleep. Sometimes $\frac{1}{4}$ grain (0.016 Gm.) of **morphine**, hypodermically, is more efficient in securing rest and sleep. Should the membranes unfortunately rupture early, how should the treatment differ? Not materially, except that increased diligence should be used in cleansing the external genitalia and in protecting, by sterile napkins frequently renewed, the birth canal from infection. Even in dry labor, we may expect, as a rule, that the natural forces will, in due time, assert themselves and accomplish the desired end—even against odds. Usually within twenty-four hours, following rupture of the membranes, labor actively sets up. If, on the other hand, delay is indefinite, great vigilance against infection is imperative. If an elevation of temperature occur, some active intervention is indicated.

In a case of *secondary inertia*, labor having begun and progressed satisfactorily for a time, but pains having become inefficient or ceased, labor at a standstill, with the cervix partially dilated, what is the course to pursue? If a horse is pulling a heavy load up a long acclivity and is far from the top, but becoming weak and exhausted, it will be folly to lay on the whip. Wiser to allow the animal to rest for a brief period, to regain strength and energy. So with the exhausted uterus. And again, if rest may not be secured without sedatives a **hypnotic or morphine** is indicated. After a few hours rest and sleep by the patient,

the reinvigorated uterus will usually resume and promptly complete its work. When the suffering is excessive, exhausting the patient and inhibiting the contractions, the author has found $\frac{1}{4}$ grain (0.016 Gm.) of **morphine** especially effective in its results, relieving the agony and accelerating labor. **Scopolamine**, $\frac{1}{100}$ gr. (0.00065 Gm.), added may be an advantage. Should a general anesthetic for the relief of such a condition be given in the first stage of labor? Usually, no. If so, the patient will plead for more and more anesthetic, requiring for the whole process of labor an excessive quantity. The enthusiasts for **nitrous oxide** anesthesia speak most favorably of its effects, some claiming even increased activity of the uterus during its administration.

If, on the other hand, the tired horse has dragged the load very near to the top of the incline, a sharp stroke of the whip will stimulate him to supreme effort, and in kindness help him quickly to complete his task. So, if exhaustion be threatened near the termination of the first stage, some stimulation may be the best treatment. Is there any safe oxytocic? Ergot is dangerous, and absolutely prohibited. One of the **pituitary** preparations may help and may possibly be employed with safety, provided it is used in minute doses.

Pituitrin should rarely be used in the first stage of labor, and if so only in small doses, say, 2 or 3 minims (0.13 or 0.2 c.c.) hourly until full dilatation is achieved.

The greatest value of pituitrin is in inertia in the second stage in which it may terminate quickly cases that have dragged on for a long time with no indication of advancement. The drug has a much larger field in multiparæ

than in primiparæ, in whom there is usually more obstruction and the perineum is too easily torn. To give a case pituitrin at once without having made an examination is dangerous and unjustifiable. Anderson (South. Med. and Surg., Jan., 1925).

[See also, for the use of pituitary, the section on PITUITARY in the first volume.]

Some have great faith in the value of **alcohol**; for instance, a glass of **sherry wine** or **port**. **Strychnine** is perhaps of some value, these latter acting as general stimulants. Strychnine may be given $\frac{1}{30}$ to $\frac{1}{20}$ grain (0.003 to 0.002 Gm.), preferably hypodermically, repeated at one- or two- or three-hour intervals. The author believes, with some authorities, that in case of weak and flabby musculature, the administration of strychnine three or four times daily in the later weeks of pregnancy will prove of prophylactic value against inertia. Small quantities of **tea**, **coffee** and **saccharose** may help in labor. **Heat** may stimulate a sluggish uterus and may be administered in the form of a hot shower or douche bath, avoiding the tub-bath.

The measures suggested are those used outside the birth-canal. What of measures within? The obstetrician should have as his motto "*Noli me tangere*," liberally and crudely translated: "Keep hands and appliances out of the birth-canal." The temptation, always great, to make repeated examinations and manipulations within has been much abused. Let us get away from the habit and avoid resulting traumatisms and too frequent infection. The author advocates and practices the attendance of many cases without vaginal or rectal examinations, depending largely in

all cases upon abdominal palpation and auscultation. On the other hand, in most cases and especially in doubtful ones, at least one thorough examination with gloved hands should be made in the birth-canal. This may exclude or correct mechanical obstruction and confirm or accomplish a favorable presentation and position. An anesthetic is indicated in some cases, that the diagnosis may be sure. Routine stretching of the cervix, for example by manual dilatation, is to be condemned. However, in cases unduly delayed, **gentle, gradual manual dilatation** may, after obliteration of the cervical canal, be properly practiced to a limited degree. The manipulation will perhaps stimulate contractions. A **hot vaginal douche** may be helpful.

Other resources having failed, intrauterine irritation may become necessary. This may be by **gauze**, packed firmly into the cervical canal and vagina. The best of these devices, however, is a **conical hydrostatic bag**, introduced through the partially dilated cervix. This stimulates pains and dilates the cervix. Traction may be made upon the bag during uterine contractions. Occasionally, when the pains are infrequent and inefficient, the intra-uterine introduction of a **bougie** may be indicated. [See Induction of Labor.]

In certain serious emergencies the **cervix**, of course, may be **incised** or **vaginal hysterotomy** performed as a surgical termination of the first stage of labor. Most or all of these intra-vaginal and intra-uterine manipulations should have the facilities afforded only by a hospital.

The patient should sit or stand or walk a portion of the time and be en-

couraged to relax between pains. The physician, supplemented by a sensible, cheerful nurse, should give moral support to the patient, aiding her to assume and maintain a hopeful and confident state of mind, confident that all will end well. Proper **liquid nourishment** should sustain her strength. The lower bowel and the bladder should be kept empty. Proper rest, by artificial means if necessary, should be secured. If at any time it becomes necessary to interfere, good conservative judgment should lead one to select those measures adapted to the needs of the individual case.

Pelvimetry, carefully made, should be a routine procedure in all primiparæ and in all cases with a history of difficult labor. If external measurements indicate any narrowing, or if the measurements show a relative disproportion, internal pelvimetry should be done. This includes palpation of the pubic arch and of the pelvic cavity, but especially taking the diagonal conjugate, from which the true conjugate can be approximately estimated. If the true conjugate denotes only a relative contraction, not less than 7.5 cm., a successful labor by the natural route may be anticipated; otherwise Cesarean section is usually imperative.

If within the latter two months of pregnancy the head engages, the obstetrician can feel that "all's well." If this does not occur, estimation of the size of the fetal head should be made. Some rely upon cephalometry, but it is a refinement that others have not attained. The author would urge at least attempted fitting of the head into the pelvis by suprapubic manipulation and by the vagino-abdominal method.

If by the end of the thirty-fifth week engagement of the head cannot be accomplished, the attendant has one of two courses—either prompt **induction of labor**, or to allow the patient to go to term with **Cesarean section**, provided the test of labor fails.

Some claim favorable results in preventing over-size development of the fetus by eliminating starches and sugars and reducing liquids to a minimum of one pint a day (**Prochownik's diet**) in the last six or eight weeks of pregnancy. Perhaps the induction of labor at the thirty-second to the thirty-fourth week of pregnancy would be the elective treatment; or, giving the test of labor at full term, which, failing, would indicate Cesarean section.

The **postural treatment** has been little recognized, and consequently few obstetricians use it in their methods of treatment. In practice various positions offer valuable assistance.

The **lateral postures**, right and left, may be of service in posterior positions of the anatomical head, or in anterior positions in which, by turning the patient on the side, the pains are intensified. Their *rationale* is not clear, but the supposition is that they overcome the extreme uterine obliquity present in these cases, causing the fetal spine to be straightened and consequently to become more rigid. This makes it possible to carry the force of the contraction directly along practically a straight line, in this way influencing and increasing flexion or extension of the head, according to whether the vertex or face presents. The patient is turned on that side corresponding to the position of the presenting part, in R. O. P. vertex cases, on the right side, or, again, face L. M. A. on the left side.

In these malpositions, rotation may thus be promoted.

The **lateral prone postures**, right or left, may aid in a manner similar to the simple lateral postures. Modified by raising the hips by means of folded sheets, this posture may help in replacing a prolapsed cord, or in delaying a threatened precipitate labor.

The **knee-chest position** has been recommended by many as a manipulative position for purposes of operation. It is claimed that versions can be more readily done and that a prolapsed cord will of its own weight fall back into the uterus. In prolapsus funi a deliberate **version** is far preferable to measures such as this or others, at best uncertain and not reliable.

The **exaggerated lithotomy** and the **Walcher positions** are hyperflexions of the lower trunk and legs in the first named, and exaggerated extension of the same in the last named. The lithotomy position is the usual position for delivery in this country. By assuming this decubitus, the pelvic outlet is materially enlarged in all its diameters, at the expense of the pelvic inlet. Its *rationale* is the reverse of the Walcher, which will be more fully explained below. Indications for this position would hold only in contractions at the outlet or for the purpose of increasing the diameters of the outlet in normal cases. This would obtain in cases in which the head remains fixed for many hours at the outlet, owing to an apparent or real minor contraction of that part, possibly as a result of a pseudomasiculine type of pelvis.

In the Walcher position we have a really valuable source of assistance. By hyperextension of the trunk, the buttocks overhanging the table and

the feet swinging free over the floor, the patient being held in place by roller sheets passing under the armpits, there occurs an increase in the size of the diameter of the pelvic inlet of from $\frac{1}{4}$ to $\frac{1}{2}$ inch, at the expense of the pelvic outlet. This increase in the conjugata vera is primarily due to a rotation of the iliosacral joints.

This position is indicated in minor pelvic contractions when the head fails to engage. The patient may be placed in this position and left there for some time till the head engages. In versions for minor contractions as the head passes the pelvic inlet it is of great service. But it must be remembered that the enlargement is always at the expense of the outlet, and, as the presenting part passes the obstruction, the patient must be thrown into the exaggerated lithotomy position to enlarge the pelvic outlet.

The **Trendelenburg posture** is of great value as a position for the total extirpation of the pregnant uterus or in acute collapse after labor. The patient lies upon her back on a plane inclined 45° or less, the lower part of the trunk the higher, the legs being flexed over the foot of the inclined plane. It has been advocated for versions and may be of help in replacing a prolapsed cord. An ironing-board or a reversed chair will answer every purpose for this position, the patient being fastened by rolled sheets.

SURGICAL TREATMENT.—**Deep incisions into the os uteri** after the disappearance of the cervix are sometimes indicated in cases demanding rapid delivery. Two to four incisions are made, reaching to the cervicovaginal junction. The field for this operation is extremely small, and

limited to those cases in which instant delivery is indicated: rapidly deepening coma from eclampsia, embolus of the lung, severe accidental hemorrhage, impossibility to dilate by other means a spastic or cicatricial os. The presence of the cervix is a contraindication to its performance, since, with this, we get a persistence of the internal ring. Its effacement can be effected by dilating the cervix by the rubber bags or the finger until the cervix has merged into the lower uterine zone.

DEEP VULVOVAGINAL INCISIONS, on one or both sides, are a means of enlarging the vaginal outlet when, from immaturity or rigidity on the part of the patient, spasm or old cicatrices make delivery highly dangerous to the integrity of the parts, or impossible. Starting at a point superior to the posterior fourchette a deep cut is made obliquely downward and outward from the vagina, which effects an incision through, not alone the sphincter ani, but also the anterior fibers of the levator-ani muscles. (See Episiotomy.)

This produces a diamond-shaped wound, which can be readily stitched up after the delivery. Its advantages over a simple **perineal incision** are evident, when we remember that such a very superficial incision has always a tendency to tear farther and so produce irregular lacerations, difficult to sew up, instead of clean, surgical incisions which come together by suture with great nicety.

FORCEPS.—This most important and useful instrument in the entire domain of obstetrical surgery is both conservative and preservative: Conservative in the sense that it saves both mother and child the results of physical in-

jury; preservative by actually anticipating the possibility of immediate or ultimate death of the mother or her unborn child. Still, the **forceps** should never be used unless there are positive indications for its employment. The head must be in a normal position, or so relatively normal that operative interference will readily convert it into one. It is always better, however, to convert faulty positions by manual methods before having recourse to instrumental interference. In a face case, chin behind, for instance, manual flexion of the head should be resorted to, to convert it into an occipitoanterior, forceps delivery being then accomplished. The forceps is applicable only when the membranes are ruptured, which may be done immediately preceding forceps application, and when the cervix is nearly fully dilated or dilatable under anesthesia. The head must be engaged or at least fixed at the brim. Engagement of the head—a condition in which the largest circumference of the presenting portion has passed the pelvic brim—generally indicates that there is no undue disproportion and that the head can successfully pass through the pelvis.

We do not sanction the application of forceps to the head above the brim except for one indication, namely: when rupture of the uterus exists or is impending. In all other cases of floating head, we decidedly prefer the elective **version**. We fear causing a rupture, in threatened cases, or increasing the tear in already present ruptures, by doing version. Again, we do not advocate the true high forceps application, because non-engagement of the head means either a malposition or malpresentation, or

a pelvis that is relatively or absolutely contracted.

In pelvic contractions, especially of a minor type, the mechanism of labor is different from that which takes place in normal ones. The head often engages transversely instead of obliquely. Since many pelvic contractions are anteroposterior, with compensating increase in the transverse diameter, it would appear that nature conforms with what would be an ideal attempt on her part to overcome the dystocia. If the forceps is applied as usual along the sides of the pelvis, pressure is exerted from side to side. According to observation, the pressure from side to side causes an increase in the biparietal diameter, which conforms to the contracted anteroposterior diameter, and in this fashion increases the pelvic contraction both relatively and absolutely. For this reason version is elected, for, under the above conditions, the after-coming head, descending, as it should transversely, pressure is exercised by the anteroposterior contraction on the parietal bosses. This diminishes their diameter where the greatest contraction exists and affords compensatory side-to-side enlargement, which conforms to the enlarged transverse diameter. This, we believe, explains the superiority and safety for both mother and child of version over the high forceps application.

Among the 8.32 per cent. which were forceps deliveries out of a total of 17,942 deliveries in the Freiburg women's clinic, the total infant mortality was 3.78 per cent. Rittershaus (*Monat. f. Geburtshilfe u. Gynäk.*, May, 1925).

To repeat and emphasize, the prerequisites of justifiable forceps application are vertex or face presentation,

complete dilatation of the cervix, engagement, ruptured membranes, and a living child.

Forceps should never be applied, in face presentation, with the chin posterior to the transverse diameter; and seldom in vertex presentation when the occiput is posterior. The former must be first manually rotated anteriorly; the second should be so manipulated. In failure to rotate the occiput, the author and others sometimes deliver by forceps, occiput posterior, face to pubes. Perhaps the most common cause of failure of a successful outcome is attempted delivery through a partially dilated cervix. The life is often "dragged out" of the fetus and the mother seriously or dangerously injured. Infinitely better is a little more patience in awaiting complete dilatation or assisting in its accomplishment.

Another common mistake is that of making undue traction, the forceps once properly applied. Perhaps the attendant has made a mistake in judgment, that the head was only fixed and not engaged. Maybe he was mistaken and the presentation or position is not correct. The force of traction is best gauged by the operator using the strength that may be exercised by the forearms as he stands squarely upon both feet.

It sometimes seems to be an excited obsession of an operator, once the forceps is applied, to "get the child out" at all hazards or at any cost, by making violent traction such as common sense—much more obstetric sense—should tell him would crush the life out of the child and inflict desperate traumatism upon the mother. Infinitely better to have done craniotomy upon the living child and to have saved the mother. However, craniotomy

upon a living child seldom seems necessary and is perhaps never justifiable. Other methods are always available.

If after a fair, careful traction, the head does not advance, the only proper procedure is to remove the instrument and re-examine. **Podalic version** and **breech extraction** will often happily relieve a trying situation. Frequently, **manual correction** may readily put the presenting part in a favorable relation for a reapplication of the forceps and a prompt delivery. The author wishes to emphasize the value of palpation of an ear of the fetus in diagnosing malpositions. If the child is dead, **craniotomy** should precede delivery.

The forceps blades should be applied to the sides of the fetal head, or approximately so, in the biparietal diameter. Here, again, palpation of an ear will aid. However, all good operators have made perfectly successful deliveries with one blade in the temporal area and the other in the posterior parietal region. As delivery progresses, rotation may aid the operator in adjusting the blades to the parietal areas.

Traction is the sole function for which forceps should be used. Experts claim the ability to use the instrument safely as a rotator. If so, the average operator dare not rashly face such danger; and could not the expert quite as successfully, and much more safely, have accomplished the end sought, by the hand?

Traction should imitate nature, in her expulsive efforts, by intermittence—traction and rest. Uterine and voluntary force should, if possible, be the chief factors in delivery of the child, the forceps merely artificially aiding at the height of pain. The pull should, of course, be in the direction of the axis of the birth-canal. If the head is

high, the mother on her back, traction should be downwards and backwards.

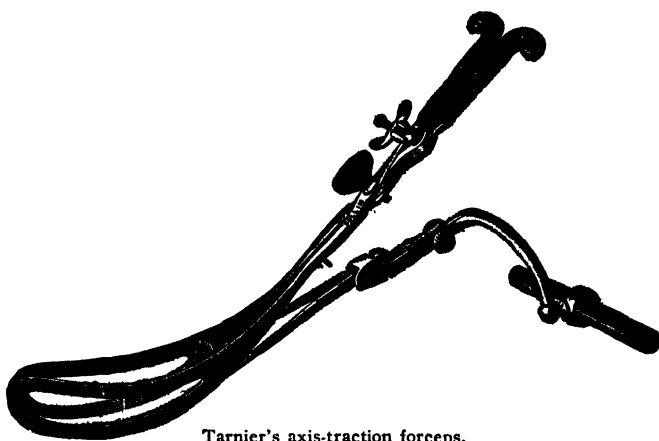
This naturally raises the question as to the type of forceps most desirable. The author has long held that any case suitable for forceps can be delivered with the simpler **Simpson type**. It depends chiefly upon the man and not upon the instrument. A good instrument requires, of course, that the blades be so shaped as to fit the fetal head, to grasp it firmly and securely without undue pressure either upon the fetal head or maternal tissues. The simple instrument, if made of good length, readily lends itself to axis traction. After satisfying himself that the instrument is properly applied, the operator with one hand grasps the handle and makes traction in the direction of the latter. At the same time, with the other hand in the region of the lock, pressure is made directly downward, the latter hand serving as a fulcrum. The resulting force is downward and backward, an axis traction, so to speak, — a traction in the direction of the axis of the birth-canal.

Good operators differ in practice at the moment of delivery of the head. Some remove the forceps immediately before delivery. Others equally good deliver the head with the instrument, one hand managing the instrument, the other protecting the perineum. In either case the latter should be done.

The **Kielland forceps**, as described by Greenhill, are somewhat lighter in structure than the ordinary forceps; the lock is sliding in character, and the pelvic curve is extremely small. The blades can always be applied to the biparietal diameter; hence the instrument is particularly adapted where the head is high and the sagittal suture runs transversely. The slight pelvic curve is to face the occiput. The anterior blade is first inserted, with the concave surface of the

cephalic curve facing the symphysis, horizontally along 2 fingers in the vagina (these fingers having been placed on the head, under the anterior lip of the cervix), until the tip has passed the symphysis. The handle is next depressed and the blade carefully pushed up into the uterine cavity, then rotated 180° in the direction of its pelvic curve. The posterior blade is inserted to that side of the first blade which will favor locking without the necessity of crossing the blades. Spontaneous rotation of the head takes place when traction is exerted.

and the point of junction of the traction rods with traction cross-handle, must always be nearly in contact, just barely touching, and this relation must be maintained until the patient is practically delivered. To allow the two parts to come into contact will at once influence the utility of the handle-tips as indices, for the tendency would then be to push the handles too rapidly forward and so



Tarnier's axis-traction forceps.

The indications for the use of the **axis-traction** (*Tarnier's*) instrument are in nowise different from those of the ordinary forceps. Nor does their application differ from that of the latter. It is only after they are locked and ready for use that the mechanism begins to differ. In their use the following rules must always be adhered to:—

The handles of the blades must be a guide as to the direction of traction, no matter what their position. The position of the blade in its relation to the pelvis must never be taken into consideration and certainly must never influence us as to the direction of our traction energy. The button on the traction handle,

give us a false conception of the true and ideal axis-traction; its effect would thus be spoiled and our energy rendered futile. Traction is then to be made and continued, the traction handles carried farther and farther forward and upward until the head begins to crown. It is now advisable either to remove the forceps, or, if the head is to be delivered solely by the forceps, the operator stands to one side of the patient, and grasps both traction rods and forceps handles in one hand, while with the other he manages the perineum.

Version, a turning of the child so as to substitute for the part presenting, some other fetal part, is named cephalic or podalic—the former when the head

is made to present, podalic when the buttocks are made the presenting part. According to the method employed, it is called external, internal, or combined version.

Cephalic version is rarely done except in correcting a shoulder presentation, more rarely in substituting the head for a breech presentation. The former by the external method, one hand upon the breech, the other upon the head, is often such an easy manipulation that it should always be tried in the latter weeks of pregnancy or early in labor. Conversion in a primipara of a breech into a cephalic presentation is, theoretically, very desirable, but not always, by external manipulation, practicable. If not accomplished by the external method, usually it is advisable to conduct the case as a breech throughout.

The *combined* or *Braxton-Hicks method*, manipulation with a hand externally upon the fetal parts and with two fingers within the cervical canal, is sometimes useful when external version has failed to convert a shoulder presentation into either a cephalic or breech presentation. Its chief value, perhaps, is in doing podalic version in order to staunch the blood in placenta previa. (See PLACENTA PREVIA.)

On mention of version, internal *podalic version* is at once thought of, the value and advantages at times of the other two methods often being overlooked. While a large proportion of obstetricians are not ready to follow the lead of *I. W. Potter*, of Buffalo, and deliver their cases routinely by version and breech extraction, yet the procedure is recognized as most valuable in several conditions. It is indicated sometimes when immediate action is necessary and forceps is imprac-

ticable or contraindicated, for example, in placenta previa, prolapse of the cord, or eclampsia; also in shoulder presentation—early cephalic version having failed; in delayed first stage occipito-posterior position, or face presentation, and especially in pelvis of moderate relative contraction, flat pelvis particularly, in which the head fails to engage. (See Forceps.)

The conditions essentially present to allow or justify the maneuver are complete dilatation of the cervix, the presence of amniotic fluid, no excessive fetal and pelvic disproportion, and the absence of tetanic contraction or contraction ring of the uterus.

The most conscientious and diligent care as to surgical cleanliness must be observed. With the patient in the lithotomy position, the bowel and bladder empty, the hand (gloved) of the operator is used, the palm of which most naturally faces the fetal abdomen. The hand, folded into a cone, is slowly and carefully introduced until the membranes are reached, which, if not already ruptured, are perforated with the finger; the presenting part is gently pushed aside, the hand within the amniotic sack seeking a foot. The procedure is done with the patient under complete anesthesia, with thorough relaxation. If a uterine contraction occurs, the hand should be allowed to rest limp until the contraction ceases. A foot having been seized, it is gently drawn down into the vagina, simultaneously pushing the head with the external hand towards the fundus of the uterus. It is desirable to secure that leg which will most readily come anterior when the version is completed. Having done the version, nature's efforts at expulsion may be awaited, or the condition may be such as to demand

prompt delivery by **breech extraction**. (See under Breech Presentation.)

Symphysiotomy, cutting through the pubic joint, and **pubiotomy (hebo-stectomy)**, sawing through the ramus pubis, are means of enlarging a contracted pelvis, increasing the true conjugate 1 to 1½ cm. and the other diameters of the inlet twice as much. Of the two procedures, most operators give preference to the latter as being the more favorable as far as the mother is concerned.

Operators of the largest experience have discarded these operations in primiparæ, and will not perform them in cases complicated by heart and kidney diseases, infection of the parturient canal, extreme obesity, colossal varicosities of the genitals, nor extremely large child. In general, their field will be limited to pelvis having a true conjugate of not less than 7.5 cm. when the conditions for Cesarean section are not ideal.

When, in a multipara, in a case of the type under consideration—of moderate pelvic contraction—expectancy has shown that the head is too large to go through spontaneously, and a gentle trial with the forceps has proved the disproportion to be greater than was expected, **pubiotomy** is the operation of choice, provided both mother and child are in good condition. The best time for Cesarean section is gone by, but the section of the pubis offers excellent chances of saving the two patients. This is an advantage of pubiotomy—it enables us to subject the woman to the test of labor.

Cesarean section, removal of the child through abdominal and uterine incision. The indications are either positive or relative. The former exists when the birth-canal is narrowed

to such a degree that the child cannot—even by embryotomy—be delivered with safety to the mother. It is generally considered that a pelvis with an internal conjugate of 7 cm. or less, renders the case one necessitating Cesarean section.

The relative indications, stated broadly, are present when, in the judgment of the obstetrician, Cesarean section offers a better chance for mother and child than delivery from below. This class is made up largely of those cases of moderate pelvic contraction—an internal conjugate of 7 cm. or more, but considerably less than the normal of 11 cm.

By careful antepartum study, induction of labor before term, the test of labor at term (not infrequently with spontaneous delivery), forceps delivery, podalic version, possibly pubiotomy, or Cesarean section after the beginning of labor—these are all carefully weighed and passed upon by the judgment of the conscientious obstetrician.

Eclampsia, central placenta previa, abruptio placentæ, uterine rupture and cancer of the cervix are conditions occasionally indicating Cesarean section.

In cases in which it is feared infection is present, and especially in which it is clearly indicated by fever and rapid pulse, the operator should hesitate to take the risk. If undertaken, a **Porro** or a **modified Porro** should be done—**supravaginal hysterectomy**.

The classic Cesarean includes the longitudinal incision of both abdominal wall and uterus without delivery of the latter from the abdominal cavity, in evidently clean cases. In doubtful cases as to infection, the uterus should be delivered before its incision. The peritoneal cavity can better be protected from the amniotic fluid. Careful su-

ture of the wounds is of utmost importance. Bleeding, if **ergot** and **pitu-itary** are previously administered hypodermically, is not serious and generally needs no special control except by suture. With apparent infection, extensive fibroids or severe uterine rupture, **supravaginal hysterectomy** should be done according to the usual technique. Occasionally carcinoma of the cervix will indicate complete hysterectomy.

Perfect suturing will reduce the incidence of weak Cesarean scars. Chromic catgut is satisfactory. If possible, the uterine wound should not be closed until firm muscular contraction has occurred. A patient once subjected to Cesarean should enter the hospital several weeks prior to expected confinement, in order to have the benefit of immediate operation if rupture occurs. T. O. Gamble (Bull. Johns Hopkins Hosp., Mar., 1922).

Realizing the high maternal mortality attending the classic operation when the case is frankly infected, the profession has sought means of overcoming this danger. Much was hoped for **extraperitoneal section**, by incision immediately above the pubis, dissecting up the peritoneum, and pushing aside the bladder in such a way as to expose the lower uterine segment, through which the child is delivered. But the operation, on the whole, has been disappointing. It is technically difficult, often attended with much traumatism, and infection of the connective tissues is prone to result.

Many operators, Beck and De Lee especially, are highly in favor of the low uterine incision, which may be called **laparo-trachelotomy**. After abdominal incision immediately above the pubis, the peritoneum covering the uterus is incised transversely directly above the bladder. The bladder is

bluntly dissected downwards from the uterine wall, and the uterine peritoneum reflected upwards. The uterine muscle is thus laid bare, and through it a longitudinal incision is made. The peritoneal cavity is meanwhile carefully protected from soiling.

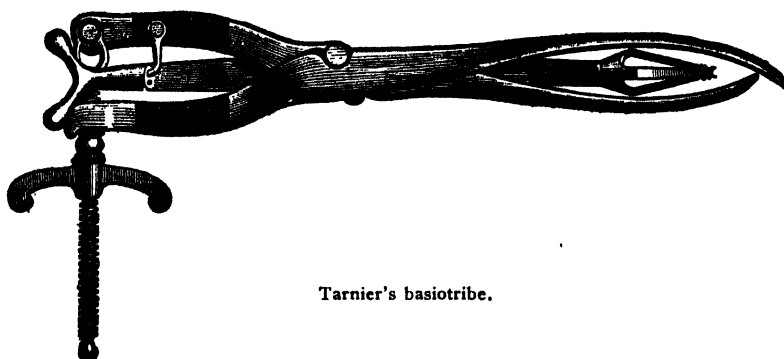
In completing the operation the uterine muscle is carefully sutured, the bladder restored to its proper position, and special care taken in covering the uterine wound with the peritoneum—the upper and lower peritoneal flap overlapping somewhat. Some of the advantages claimed are, less shock because less handling of viscera, less probability of adhesions or subsequent uterine rupture, and particularly less danger of infection, which, if it occurs, is likely to be extraperitoneal and localized, and can be readily dealt with.

Classic **Cesarean section** is easier and more rapid than **cervical hysterotomy**, either suprapubic or vaginal, but entails danger of rupture of the scar in a future pregnancy. No case with membranes ruptured and known or suspected infection is suitable for the classic Cesarean. Other drawbacks are that it may permit soiling of the peritoneum with liquor amnii, which may be infected, and is quite frequently followed by adhesions of the uterine scar. Also, the rhythmic contractions and involution of the uterus tend to render slack the uterine sutures, preventing uninterrupted healing. The low-incision **transperitoneal hysterotomy**, opening only the cervix and lower, non-contractile zone of the uterus, isolates the area of operation from the peritoneal cavity. The risk of rupture in future pregnancies is almost entirely eliminated.

The experiences of De Lee and Cornell and of King demonstrate the safety of this operation, even in cases exposed to infection by vaginal examinations, forceps applications, and rupture of membranes. L. Peters (Cal. State Jour. of Med., June, 1923).

While the mortality of 338 **laparotomies**—mostly under ether—was but 0.66 per cent., this can be further lowered by **local anesthesia**. The patient's mind is first prepared for the procedure, if time permits. The anesthetic is 0.5 per cent. **novocaine**, to each ounce of which, after it is sterilized, is added 2 drops of 1:1000 **adrenalin**. The average amount of solution used is 7 ounces, and the range, $3\frac{1}{2}$ to 10 ounces. The procedure comprises successive infiltration of the abdominal incision, superficial fascia, intercostal nerves as they enter the rectus sheath, peritoneum, cavity of Retzius, and subperitoneal space of the vesico-

of the cervix and lower uterine segment, two incisions are made through the vaginal wall, one-half encircling the cervix, another at right angles joining the first in the mid-line of the anterior vaginal wall. Through this free opening the base of the bladder is reached, this organ being freed by blunt dissection from the anterior uterine wall as high, if need be, as the vesico-uterine peritoneum. The latter should not be opened. Meanwhile, step by step, the cervix fixed and drawn down by volsellum forceps, the anterior uter-



Tarnier's basiotribe.

uterine plica. The uterus itself is not desensitized unless the patient is in active labor, in which case a few cubic centimeters are injected in the line of incision. During the delivery of the child, about $\frac{1}{2}$ the women require a little gas. By the time consciousness has returned the placenta is out—usually through traction on the cord,—and 3 hypodermics are given: **Pituitrin**; **morphine**, $\frac{1}{4}$ grain (0.015 Gm.), and **scopolamine**, $\frac{1}{200}$ grain (0.0003 Gm.). J. B. De Lee (Surg., Gyn. and Obst., Feb., 1925).

Vaginal Cesarean section, or colpo-hysterotomy, is a measure that may occasionally be used with advantage when the cervix is tightly closed or it is the site of some obstruction, and an indication arises for quick delivery.

In order to reach the anterior wall

ine wall, including the cervix, is split in the mid-line with scissors. This opening may give room for the delivery of the child. If not, the posterior wall is also split, pushing the peritoneum off, if incision is necessarily so high, from the bottom of Douglas's pouch.

It may be indicated in acute heart or lung affections, eclampsia, abruptio placenta or fetal asphyxia. Cancer of the cervix and stenosis of the cervix from old scars may be indications. The field for this operation is quite limited. Delivery of a living child from below must be possible; therefore the pelvis must be large enough and the position and presentation of the child favorable. The operation simply overcomes the resistance of the cervix and is one not

to be undertaken by one unskilled in pelvic surgery.

Surgical Measures Indicated in Fetal Obstruction.—These are all destructive to the child; they are, however, conservative, since they are preservative to the mother. In actual practice our first duty is to the mother, and under no condition should danger to the child influence the obstetrician in increasing the danger to the mother, unless, of course, the full consent of both parents is obtained. Where mother and baby have equal chances, those chances should be well weighed and operative influence estimated. In all difficult and prolonged labor cases in which many operators have examined and many instruments have been used, and operations have been attempted and failed, the child, as a result of these prolonged, fruitless, and severe manipulations, has often suffered so severely as to have been nearly or already sacrificed. In such cases, a deliberate **perforation** ought always to hold preference. The perforator is an instrument still possessed of a large field of application. It is our rule to perforate or dismember in all cases in which the child is dead, no matter what its position in the pelvis is, except where the head can with safety to the mother be delivered by instrumental or manual extraction. We therefore have at our disposal the following operations: 1. **Basiotripsy.** 2. **Total embryotomy.** 3. **Decapitation.** 4. **Cleidotomy.** The writer, in cases indicating **craniotomy**, has frequently perforated with Smellie's scissors and then delivered with forceps.

BASIOTRIBE.—In the place of the **cranioclast**, the **basiotribe of Tarnier**

has proved a wonderfully successful and staunch instrument. When once it is in place, it holds on "like grim death." Its application is somewhat complicated, since its three distinct parts act in unison, the central part the perforator, on each side the heavy cephalotribe-like blades gripping, not alone the head, but the base of the skull.

TOTAL EMBRYOTOMY is rarely performed since one or the other of the destructive operations will usually answer.

DECAPITATION.—In impacted transverse or shoulder presentations a deliberate **decapitation** will nearly always precede an **embryotomy** if the latter operation is at all necessary. But when after decapitation it is impossible because of spasm to deliver, dismemberment is in order; or, if the child be macerated, it is also indicated, since a purchase on one or both feet will result in their being torn off. In locked twins it may become necessary to decapitate one or both children.

CLEIDOTOMY, or cutting through one or both clavicles, is one of the new destructive operations. It is indicated in impacted shoulders either in case of spastic contraction or when the shoulders are abnormally developed and large. Thus, occasionally, after delivering the head, it is impossible to deliver the trunk because of a pair of enormous shoulders. The child promptly dies, and brute force would only succeed in making frightful lesions of the genital tract. If now a pair of stout scissors are introduced and the clavicles are deliberately cut through, the chest instantly collapses, its diameter is diminished, and speedy delivery follows.

ARTIFICIAL ABORTION AND INDUCTION OF LABOR.—The term "abortion" is applied when the uterus is emptied of the product of conception, either spontaneously or artificially, before the fetus is viable, that is, before the ovum or fetus has reached that stage of development when it is fitted for extra-uterine life. Artificial abortion is a procedure performed purely in the interests of the mother. Premature labor, on the other hand, when induced, carries with it the assumption that the fetus is viable,—that is, that it is capable of surviving apart from the mother. The operation, then, is resorted to both in the interest of mother and child, although ordinarily those of the former chiefly urge the physician to resort to it. The induction of premature labor is, in general, an elective operation; artificial abortion is usually forced upon the physician. The factors calling for each operation are different, as are also the methods of procedure. It is useful, therefore, to consider them separately.

Except in strict emergency, induction of abortion or labor should never be done without the support of a consultant.

THERAPEUTIC ABORTION is rarely indicated. Among the conditions sometimes demanding abortion are **pernicious nausea** and **vomiting** with evidence of **toxemia**, **advancing tuberculosis**, **decompensating heart disease**, **nephritis** especially with **complicating retinitis**, **diabetes**, and other diseases that seriously threaten the mother's life, such as **leukemia** and **Basedow's disease**. **Bleeding** to an alarming extent may necessitate emptying the uterus, as well as diseases of the ovum, *e.g.*, **hydatiform mole**.

Methods.—Artificial abortion, in the first three months of pregnancy, can best be completed in one stage or sitting. It is imperative that it be done with the greatest surgical cleanliness, the technique as careful as if the abdomen were to be opened. This includes hands and dress of the operator, rubber gloves, all instruments and appliances sterilized by boiling, drapery for the patient, and the surgical preparation of the vulva and a large surrounding field, shaving of the parts being among the first steps in the latter.

The patient being in lithotomy position, under general anesthesia, the vaginal walls are retracted, the cervix fixed with volsellum forceps, and the cervix dilated, preferably with graduated metal bougies, if it is readily accomplished, to a degree admitting a gloved finger. With a hand on the abdomen, the uterus may be pressed down upon the internal finger with which **digital curetment** (cureage) empties, or almost completely empties, the uterus. With a flush curet (using a stream of sterile water or mildly antiseptic fluid), the uterine cavity is very cautiously but thoroughly **curetted**—cautiously, because the operator should always bear in mind the extreme ease with which the puerperal uterus is sometimes perforated. No packing need be introduced unless bleeding persists or the operator fears that portions of the secundines remain. If dilatation to admit a finger is not practicable, the uterus may be emptied solely with the curet, or, rarely, with the aid of the **ovum forceps**. The latter is also a dangerous instrument and, if employed, should be used only with great caution.

After the third month, it is usually advisable to do the operation in two stages. On the first day the cervix is

dilated, the amniotic sac punctured and the lower segment, cervix and vagina packed with gauze. Usually within a few hours, pains set up and generally continue, sometimes expelling the contents of the uterus, or at least dilating the cervix sufficiently, within 24 hours, so that the uterus may be artificially emptied, as indicated above. Sometimes, within the second three months, especially if pregnancy approaches the period of viability, the procedures employed for the induction of premature labor (see below) are used with the best advantage. Wherever possible, in emptying the uterus, the fingers are to be used. The after-treatment should include external surgical cleanliness (no internal douches), **ergot** and **strychnine** four times a day, and rest in bed for at least one week, with the head of the bed elevated.

THE INDUCTION OF LABOR.

—By this is meant the interruption of pregnancy after viability; if before full term, it is called premature labor.

Among the most common conditions justifying the procedure are a **contracted pelvis** or an **over-sized child**, and **disease seriously threatening the life or future health of the mother or the life of the fetus**. Most of the conditions mentioned under THERAPEUTIC ABORTION may be included, and in addition are **threatened eclampsia**, **placenta previa**, **abruptio placenta** and various **psychoses**. The habitual death of the child before term, or pregnancy prolonged beyond term, may be an indication. When done for the sake of the child, there must be assurance of life and viability of the child, as well as of a pelvis sufficiently large. The chances of long survival of a child delivered before the thirtieth week are very small.

Methods.—While drugs are entirely unreliable, many believe that giving small doses of **strychnine sulphate** for a few weeks previously, $\frac{1}{40}$ gr. (0.0016 Gm.) *q.i.d.*, gives tone to the uterine muscle, and if induction of labor is contemplated, the dosage may be increased at that time. A large dose of **castor oil** is occasionally followed by labor.

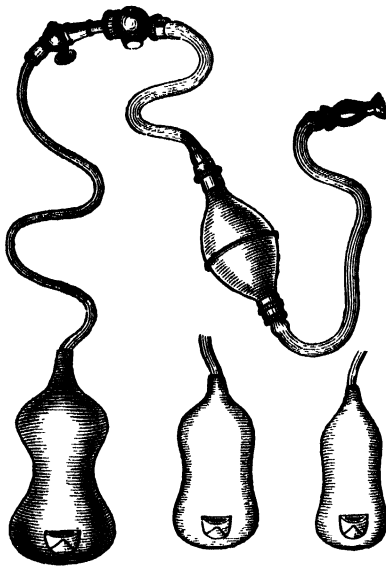
Some observers testify to the efficiency of one or two large doses of **quinine**, preferably in solution, 10 to 15 grains (0.6 to 1 Gm.), the latter sometimes to supplement the oil.

In public wards, the writer found effective in 90 per cent. of cases 1 ounce (30 c.c.) of **castor oil** at 6 P.M., 10 grains (0.6 Gm.) of **quinine hydrochloride** at 7, an enema at 8, quinine again at 9 and at 12, and if pains did not begin by 9 A.M., $\frac{1}{2}$ c.c. (8 minims) of **pituitary extract** intramuscularly. If needed, the latter is repeated $\frac{1}{2}$ -hourly up to 6 doses. B. P. Watson (Amer. Jour. of Obst. and Gyn., Dec., 1922).

The approved methods include the intrauterine use of **bougies**, of the **hydrostatic bag** and of **packing**. The simpler and perhaps the safer method from the standpoint of infection is that of packing the lower uterine segment lightly and the cervical canal firmly with a strip of gauze three inches wide and several yards long. (See surgical cleanliness under THERAPEUTIC ABORTION.) This may be readily done, usually without anesthesia, in the lithotomy position, and vaginal retraction effected, exposing the cervix. The latter, steadied by tenaculum forceps, can usually be dilated with a finger, or if not, with large solid metal dilators. Gauze may then readily be introduced with uterine dressing forceps or through a packing tube, care being exercised not to rup-

ture the membranes. The author usually packs the vagina also.

Many depend largely upon the introduction of **bougies**. The danger of infection is slightly more than other methods, but can be averted by scrupulous aseptic technique. The membranes are sometimes accidentally punctured and rarely severe placental hemorrhage has been set up. Anesthesia is not generally necessary.



Barnes's bags.

The cervix is slightly dilated as outlined above. Preferably, two, in succession, soft rubber sterile bougies, large catheters or small rectal tubes, are passed into the uterus behind, in the direction of the fundus. They, of course, should be inserted between the amniotic sac and the uterine wall. If the former should be adherent at the internal os, it should be gently separated by the finger. The effect of the tubes may be aided by packing a narrow strip of **gauze** into the lower uterine segment and the cervix.

The upper vagina should also be tamponed.

There are advantages, at times, in the use of a **hydrostatic bag** in the lower uterine cavity. This device may be as efficient as any other in stimulating uterine contractions, and its direct dilating effect on the cervix is often an advantage. The latter is especially true when the membranes have ruptured, or when there is uterine inertia. Several types are available, but the simple conical (Voorhees) bag with a flat top seems best. It comes in a series of different sizes, made of soft rubber, fortified with fabric, a tube extending from the narrow end, which, when the bag is in position, protrudes from the vagina and through which the bag is filled.

For introducing the bag, the cervix is exposed and fixed, and if not already sufficiently open, is slightly dilated—enough to admit a finger or a good sized bougie. The bag, empty and folded longitudinally, is grasped with uterine dressing forceps and readily introduced through the cervix. Sterile water or one-half per cent. solution of liq. cresol. co. is then forced into the bag by a piston or Davidson syringe. The bag should, previous to its introduction, have been tested as to its capacity and strength. When in place, it should be distended until it is only moderately tense. The examining finger will help determine this, and slight traction on the tube will assure the operator that there is proper adjustment. The tube is clamped with a hemostatic forceps and may be held up by fastening it to an abdominal binder.

It would seem superfluous to emphasize the imperative necessity, in all these manipulations in the par-

turent canal, for the most scrupulous and conscientious care in the observance of surgical cleanliness. The bag is sterilized by boiling and the cervix should be so exposed by specula or retractors that the former may be introduced without coming in contact with vulva or vagina.

The care of the patient during induced labor does not differ materially from that necessary in spontaneous labor. The external genitalia should be well protected with sterile napkins and frequently flushed with a mild antiseptic.

The size of the bag chosen will depend upon the condition. If it is chiefly to stimulate the uterus to the onset of labor, one of the smaller ones should be chosen. A large one is more liable to displace the presenting part. When the smaller one passes from the cervix, labor may be progressing satisfactorily, and, unless there is some emergency, we may better await spontaneous progress. If, however, the contractions are weak and inefficient, or there is need of hastening dilatation, a second larger bag may be introduced, sometimes one sufficiently large to dilate the cervix completely. Moderate traction upon the tube in conjunction with uterine contraction will speed the dilatation. Care should be used not to do the latter to excess, for fear of cervical laceration.

MANUAL DILATATION.—A means, much abused, of accelerating the first stage of labor, but which may be justified and most helpful at times, is **manual dilatation**. Infection and severe injury, even to the extent of complete uterine rupture, have resulted. It may not be properly employed until the effacement of the in-

ternal os and cervical canal has been accomplished. Its use previously is attended by grave danger of extensive tear with severe hemorrhage. A common mistake is made of too great haste. Nature should be imitated by dilatation and relaxation. Anesthesia is usually indicated. When labor is delayed by fear, excitement, or pain, short complete anesthesia with moderate manual dilatation may have a wholesome effect in the subsequent spontaneous progress. If the cervix is directed too far back, it may at the same time be drawn forward. When the cervix is two-thirds or three-fourths dilated, the other conditions for forceps or podalic version being fulfilled, manual means may often readily and happily complete the dilatation.

There are two general methods, *unimanual* and *bimanual*. The former (*Harris's*) consists simply of introducing one, two, and finally all the fingers of one hand, followed by the thumb, through the os. The hand within the os is expanded so that when the closed fist can finally be drawn out the process is supposed to be complete. The *bimanual* is preferred by the author as being more rational in imitating nature; there is less danger of injury to the parts, and less likelihood of rupturing the membranes or of displacing the presenting part. It can be done outside a fetal part occupying the cervix. The forefinger of one hand is introduced within the cervix, then the corresponding finger of the other hand, the fingers back to back. Soon two fingers of each hand are introduced, with which pressure is made outward and downward in opposite direction, the knuckles serving as a double fulcrum. The points of pressure upon the cervical ring are changed

frequently, encircling the whole circumference with the dilating force. The free fingers should be protected from contact with the perineum and anus by a sterile towel.

VAGINOPERINEAL INJURIES. SURGERY OF THE PERINEUM.

—Laceration of the perineum may be described as a splitting of the perineal body, which latter directly or indirectly supports the bladder, rectum, uterus and the intestines. Various degrees of laceration are described which may be classed under the heads: "Complete" and "Partial Tears." These include the following degrees:

Superficial laceration of the fourchette and perineum, not involving the sphincter.

Laceration to the sphincter ani.

Laceration through the sphincter ani.

Laceration through the sphincter ani and involving the rectovaginal septum.

The former two are called incomplete; the latter two complete lacerations.

Not infrequently subcutaneous rupture of the muscular tissue and fasciæ of the perineum takes place, leaving the skin and mucous membrane intact. Cases of laceration of this type are called concealed lacerations and are followed, as in the other forms, by relaxation of the pelvic floor and loss of perineal support.

SYMPTOMS.—The symptoms resulting from perineal laceration are, a feeling of weakness and dragging down of the pelvic viscera, later the prolapse of the various organs resulting; prolapse of the vagina with cystocele or rectocele, one or both; and prolapse of the uterus. When the rupture is complete, to these may be added incontinence of feces and intestinal gases and prolapse of the rectum. As an excep-

tion, the patient may suffer but little even when the two passages are laid into one; but generally the patient's condition is a sad one. Fecal matter and gases pass without control, and the pelvic organs tend so strongly to descend that exercise or muscular efforts, produce a sense of weariness, pain throughout the pelvis, and traction upon the broad ligaments.

DIAGNOSIS.—The diagnosis of this condition is made by inspection.

ETIOLOGY.—The most common causes of laceration of the perineum are rapid delivery, unusually large head, a narrow rigid vulvo-vaginal outlet, a persistent occipitoposterior position, or the after-coming head in breech extraction.

PATHOLOGY.—In partial perineal ruptures there is the exposure of a more or less extensive raw surface, richly supplied with blood- and lymph-vessels. This raw surface is, as a rule, indisposed to heal by first intention and over its surface for two or three weeks there is an uninterrupted flow of lochia, consisting of disintegrated muscular tissue, decaying and flaking decidua, disorganized blood, and mucopus. In complete perineal rupture, the presence of fecal matter and intestinal gases are added. Rupture of the perineum may lead to septicemia, anterior or posterior displacement or prolapse of the uterus, cystocele, rectocele, uterine engorgement and hyperplasia, subinvolution of uterus and vagina, and more or less invalidism.

TREATMENT.—All obstetricians agree that perineal lacerations should be closed by **suture**. By far the most practice and advocate *immediate suture* for the purpose of securing primary union, if possible. Thus, hemorrhage is arrested, the probability of entrance of infection is lessened, involution be-

gins promptly, the convalescence of the patient is shortened, and she is saved the annoyance and, perhaps, the expense of a future anesthetization and operation. This school of obstetricians would delay repair in cases of extreme exhaustion, extensive bruising and swelling of the genitalia, especially with infection already present.

A smaller number of obstetricians (e.g., B. C. Hirst) favor *intermediate repair*, approximately one week following labor. Advantages claimed for the latter are that the extent and character of the wounds are more readily determined in a field now free from blood and swelling that exists at the termination of labor, that better coaptation of the wound surfaces and restoration of the structures to their normal relations are secured, and that fewer failures are experienced. At this time, the cervix will show whether it needs suture, and if so, can readily and safely be done. Most all oppose immediate repair of the cervix, especially because of the danger of introducing infection. In intermediate repair, preliminary to suture, the wound surfaces must be freshened by rubbing them with gauze or scraping with knife or scissors. Sometimes small portions of tissue will need to be excised. As a preliminary to repair, a good light is essential; small lacerations may sometimes be primarily repaired without, but usually **general anesthesia** will shorten the procedure and insure better closure of the wound. A sufficient **vaginal packing** of sterile gauze should be used to keep the field free of blood from above.

The most frequent causes defeating success (hence to be avoided) are a lack of closure of the upper angle of the wound; failure in passing the sutures to go below its depth, thus leaving a

dead space; or failure to pass the needle deeply into the tissues retracted from the median line. A mistake easily made is that of drawing the sutures too tight.

No one has a right to practise obstetrics who does not fit himself to make necessary repairs. Such ability requires only the appliances, a fair knowledge of the anatomy of the parts, and the application of the ordinary principles of surgery.

One fact should be kept clearly in mind—that perineal injuries generally involve two surfaces, vaginal wall and skin perineum, and sometimes a third, the rectal wall.

In repair of an *incomplete laceration*, the wound is first closed upon the vaginal surface, beginning at the upper angle of the tear, passing with curved needle around at right angles to the tear and beneath its depth. The interrupted sutures are passed one after another from above downward, one-fourth inch apart, until the commissure is reached. Each stitch enters upon the vaginal mucous membrane one-half inch or less from the torn surface and issues at a corresponding point on the opposite side. The sutures are tied and cut short.

When the wound is deep, perhaps involving the levator muscle, it is often advisable to close the depth of the wound with a line of sutures which will later be buried by a second series closing the overlying structures.

The wound on the vaginal surface often extends not in the median line, but in one sulcus; or not infrequently, the two sulci are involved, extensions of the tear in the midline of the skin surface. If so, two lines of suture must be used from the vaginal surface. The operation is completed by closing the wound from the skin surface, su-

turing from below upward, meeting the vaginal line of sutures at the commissure. Again, be sure that the skin sutures encompass the depth of the wound remaining. Twenty-day catgut, No. 1 or No. 2, serves the purpose of repair well. Some prefer one or two or all silkworm gut sutures for repair from the skin surface.

In repair of a *complete laceration*, particular attention must be directed to the sphincter ani, frequently to the torn and retracted fibers of the levator ani, and occasionally to the involved rectal wall.

Good assistance will be necessary. A torn end of the retracted sphincter ani should be picked up with dissecting forceps, transfixed, the needle encircling superficially around the recto-vaginal septum; it should include likewise the other end of the torn sphincter. The torn ends should be carefully coaptated by two or three sutures.

If the *rectal wall is involved*, it is closed by introducing sutures from the outside, which should not enter the gut. The needle enters and issues on the wounded surface of the rectum (Lowenstein suture), the knots being buried by the next line of suture. Working in the depth of the wound, a small curved needle armed with catgut No. 1 is best. If the rectal tear has been extensive, a second series of buried sutures may be best to fortify the first. The wound thus having been transformed from a complete into an incomplete laceration, the latter is closed as outlined above.

Very rarely a laceration occurs directly through the perineum, leaving the vulva and perhaps the anus intact. This is called a *central rupture or laceration of the perineum*. In case of such an unusual accident the treatment

would consist in cutting the bridle of tissue of the vulva remaining and then closing according to the principles of the usual laceration.

Episiotomy, incision of the vulvo-vaginal outlet, may be indicated when extensive laceration of the perineum seems imminent. This gives as a wound a clean cut instead of a ragged tear. Incision is made with heavy, blunt-pointed, straight scissors, from slightly to either side of the midpoint of the posterior commissure, in a line directed midway between the anus and the ischial tuberosity of the corresponding side. The extent of incision must be judged by the disproportion, but should be sufficient to allow ready exit of the head.

Suture of the wound should be done immediately and according to the general surgical principles of perineorrhaphy. The parts should be restored to their normal relations by suture upon both vaginal and skin surfaces, the junction of skin and mucous membrane serving especially as a guide. Sutures should be passed sufficiently deep to avoid dead space. If the wound is extensive, especially when involving fibers of the levator ani, the depth should be closed with buried sutures as a first step in the procedure.

If the steps of the operations just described are aseptic, the management of the puerperal state does not differ materially from the normal. It is unnecessary to administer vaginal douches, since the non-septic lochia will not interfere with union. It is not good practice to keep the bowels constipated. The perineal tear is more likely to heal from the depths if we prevent hardened fecal matter from collecting in the rectum. The coaptated surface may be kept powdered with **aristol** or **boric acid**, and

the nurse should be strictly enjoined to exercise scrupulous cleanliness of the external genitals.

Delayed Operation.—When primary or intermediate operation has been omitted or has failed, a plastic one, or *secondary operation*, is necessary for restoration of the pelvic floor. These operations should not be undertaken until from six to twelve months after the original injury. During this interval the general health of the patient should be looked after.

The operative procedure will vary according to the preference of the operator and according as the laceration is partial or complete. *The resection and suturing must be adapted to the tear.*

A multitude of **plastic perineal operations** have been described, but all are based either upon the classic operation of Lawson Tait or that of Emmet, the former being a flap-splitting procedure, the latter a denudation or resection as a preliminary to suture.

Tait's Operation.—No tissue is removed. In incomplete tear, the rectovaginal septum, with sharp pointed scissors, is split from side to side, the depth of this wound perhaps two centimeters. The wound is extended forward on either side, somewhat less deep, to the point where the operator estimates the posterior commissure should be. This forms a semicircle along the muco-cutaneous junction. The upper or vaginal flap is drawn upward by means of a tenaculum and the depth of the wound increased as may be necessary.

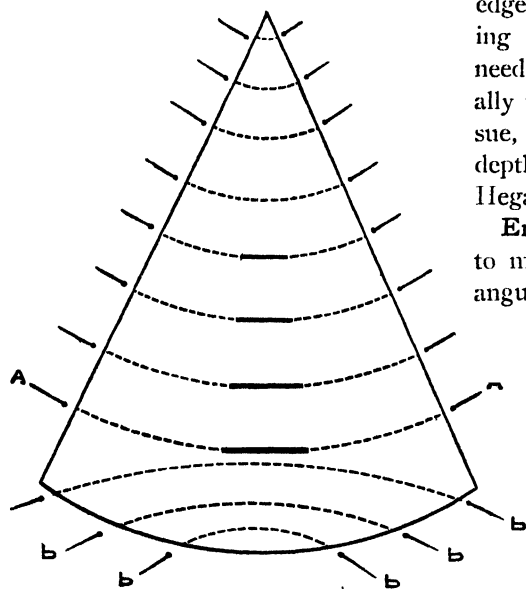
With a moderately curved needle, beginning nearest the anus, the sutures are passed transversely, entering and emerging near the edge of

the wound, the skin not being included. The sutures are concealed throughout. It may be necessary to introduce a finger into the rectum as a guide. Four sutures are generally sufficient. It is recommended that the skin edge be closed with superficial sutures.

In complete laceration, on either side of the transverse incision which splits the rectovaginal septum as described above, a downward and backward incision is carried, which goes just beyond the edges of the separated sphincter-ani muscles. A marked dimpling on each side of the anus shows plainly the location of the retracted ends of the sphincter ani, when the laceration is complete. The points must be denuded and the sutures so placed as to bring and hold them in apposition until union has occurred. The flaps of this H-shaped incision, held apart, upward and downward, form a quadrilateral. The first suture, beginning from behind, is inserted just outside and below the edges of the torn sphincter ani and brought out exactly at the same spot on the opposite side. The stitches are then introduced and tied as in the incomplete operation. It will be found necessary to introduce a certain number of superficial sutures into the perineum or along the vaginoperineal commissure, if we wish to secure perfect cutaneous union. In complete lacerations, there is more certainty of securing a perfect restoration of function of the sphincter-ani muscle and in preventing the formation of a recto-vaginal fistula than with most other methods.

In some cases, in which the laceration has been moderate and central, a simple **triangular resection** of the

vaginal wall is sufficient preparation for **suture**. From the base of the triangular resection extending from side to side in front of the anus, along the junction of the skin and mucous membrane, the denudation should reach up the posterior vaginal wall above the tear. In this way resection beyond the limits of the scar tissue will be secured. The area to be resected should be grasped and fixed and put



Insertion of sutures. A, A, Intravaginal sutures; b, b, external sutures. (After Hegar.)

on the stretch with tenaculum forceps, one at each angle. The two forceps below should be opposite the point where it is desired to construct the posterior commissure of the vulva. Resection may be done by removing successive strips with curved scissors, or, following incision along the muco-cutaneous junction, a flap of the mucous membrane to the full extent of the denudation desired may be dissected from below upward, using the finger covered with a piece of gauze, the flap then being cut off. The sutures

passed from side to side succeed one another from above downward about one-fourth inch apart, until the site of the commissure is reached. The remaining series of sutures from the skin surface should be begun nearest the anus, ending at the commissure.

Each suture, throughout, should enter on the mucous membrane or skin about three-eighths inch from the torn edge and should issue at a corresponding point on the opposite side. The needle should take a wide sweep laterally to gather up a good portion of tissue, and should go entirely beneath the depth of the wound. (See figure after Hegar.)

Emmett's operation is best adapted to many cases, because the double triangular denudation, an angle extending up each sulcus of the vagina, corresponds to the original tear. Even though the laceration has not always involved the vaginal sulci, the case is best fitted to one (there being many of them) in which a considerable rectocele exists. It is adapted to either an incomplete or a complete tear.

The area to be resected should be put upon the stretch with at least three tenaculum forceps. A forceps grasps the muco-cutaneous junction at a point opposite to the caruncle on either side. Another forceps should grasp the posterior vaginal wall at a midpoint high up, the height being best determined when, by moderate tension, the tissues may be drawn downward and forward approximately to the external meatus of the urethra. A fourth forceps may grasp the posterior commissure.

The base of the resection is formed as outlined in the operation described

immediately above, but by the extension upon the posterior vaginal wall the apices of two triangles are formed, one extending into each lateral vaginal sulcus. Resection should be sufficiently deep and wide to expose underlying fasciæ and muscles involved.

In *complete tear*, particular care must be exercised to expose the ends of the torn sphincter ani, which ends must be brought into coaptation, else the operation will be a failure. Suture of the sphincter and, when involved, of the rectal wall, should be effected as described in primary or intermediate repair.

From two to four interrupted sutures should close each vaginal sulcus, beginning at its apex. Each suture, introduced on undenuded surface, including a good "bite" of tissue, should be inserted from above downward toward the median line of the sulcus, brought out at this point, reintroduced upward, and make its exit at a point corresponding to its entrance. On tying, these sutures not only draw the tissues toward the median line, but lift them to a higher level nearer their normal position. Each sulcus thus having been separately closed, the "crown suture" is passed through the three points grasped by the tenaculum forceps. When tied, this suture brings these tissues together in apposition to form the posterior commissure. The needle, in passing this suture, should not enter the wound, but should completely encircle its depth. The wound below, appearing on the skin surface, now remains to be closed to form a part of the skin perineum. Sutures are passed from side to side, deep enough to avoid any dead space.

Routine repair of lacerations, old or new, immediately after expression of the placenta advocated. The cases thus dealt with progressed satisfac-

torily, and the wounds did not seem affected by the lochia. Delivery is effected with minute attention to surgical cleanliness. During labor only rectal examinations are made. When the pains occur about every 5 minutes and the cervix is distinctly dilated, a **morphine-scopolamine** course is started— $\frac{1}{4}$ to $\frac{1}{4}$ grain (0.01 to 0.015 Gm.) of the former and $\frac{1}{150}$ grain (0.0004 Gm.) of the latter, with smaller doses later. For delivery **nitrous oxide-oxygen**, occasionally with **ether**, is used, the patient placed in the lithotomy position, and the external genitals thoroughly cleansed and disinfected. The patient is then draped and catheterized. After delivery of the head, **pituirine**, 1 c.c. (16 minims), is injected in one buttock, and when the placenta is expelled, **ergotal**, 1 c.c., in the opposite buttock. Careful examination for and repair of cervical or other lacerations is then carried out. BUBIS (Amer. Jour. of Obst. and Gyn., Aug., 1925).

CHARLES S. BARNES,
Philadelphia.

PROTEIN SENSITIZATION.

—This term is applied to a condition in which the individual is physiologically sensitive or hypersusceptible to some foreign protein. Four types of protein have been studied more or less extensively in this connection: bacterial, plant, animal and food protein. These may act separately or in combination.

The protein may find ingress to the body in various ways: By ingestion, inhalation, absorption and infection—by ingestion through the digestive tract; by inhalation through the respiratory tract; by absorption through any abraded surface, as the skin or conjunctiva; by infection from any pathogenic bacteria lodged in various parts of the body, especially in the tonsils, teeth, lungs, nose, throat or intestines.

The poison produced by the protein is disseminated by the blood throughout the entire organism, where it produces definite reactions in the parts where absorption has taken place. We do not know why these special tissues act in this way and can merely ascribe it to an individual idiosyncrasy.

Diseases Caused by Protein Sensitization.—The most common diseases caused by protein sensitization are: hay fever, bronchial asthma, and various skin conditions, such as eczema, urticaria and acne. Furthermore, numerous digestive troubles in children have been found to be due to this condition, and so called acidosis or acid intoxication, in certain instances, has been proved to be so caused.

Hay fever is most commonly caused by the protein pollens of ragweed, goldenrod, red top, golden glow, sunflower, timothy and corn; bronchial asthma, by the emanation of horse hair, horse dander, dog or cat hair or rabbit fur, goose or chicken feathers. In some cases pollens are the primary cause, while bacterial proteins continue the condition; again, it has been found that bacterial proteins are the only cause. When the latter is the case the bacteria at fault are the *Staphylococcus pyogenes albus*, the *Streptococcus hemolyticus*, the *Staphylococcus pyogenes aureus*, and the *Micrococcus catarrhalis*.

In the inhalation type there are 4 sources, namely, 1, animal hair and dandruff; 2, pollens; 3, flour, and 4, dust. In the ingestion type there is but 1 source, namely, food. The chief food offenders in order of importance are, 1, cereals, such as wheat, corn, rice, rye; 2, eggs; 3, fish, such as lobster, salmon, mackerel, and cod;

4, casein; 5, beef; 6, chicken; 7, cocoa. Walker's proportion of the various causative factors is 20 per cent. sensitive to horse dandruff, 15 per cent. to wheat, 15 per cent. to *Staphylococcus pyogenes aureus*, 15 per cent. to early pollens, 10 per cent. to late pollens, 5 per cent. to cat hair, 3 per cent. to *Staphylococcus pyogenes albus*, and 17 per cent. to miscellaneous proteins. C. N. Hensell (Minn. Med., Apr., 1920).

Skin diseases are caused by the following food proteins in the greatest number of cases: tomato, strawberry, fish, egg white, shell-fish, almond, beef, wheat, milk, pork, oats and buckwheat.

The digestive disorders of children are caused by many different food proteins, the most common being: carrot, pork, plum, asparagus, squash and cocoa; to a less extent, beef, barley, rice, oat, pea, string bean, tomato, pineapple, egg, banana, peach, fig, strawberry, peanut, celery, corn, and lima bean.

Sensitization Test.—The two methods employed in testing for protein sensitization are the intradermal and the cutaneous. The former is not used as extensively as the latter, as it is more difficult to perform and is often quite painful; the cutaneous method is much easier, and not at all painful, while the reaction is quite as positive.

The cutaneous test is performed as follows: Beginning just below the bend of the elbow, on the inner side of the forearm, a scarification about one-fourth inch in length is made with a small sharp knife into but not through the skin. A small portion of the protein to be tested is placed over the cut, and if a dried protein is used a drop of decinormal

sodium hydroxide solution is rubbed in, using a sterile toothpick; this facilitates absorption. If a protein in solution is used, the decinormal sodium hydroxide solution is not employed. The scarifications should be at least one-half inch apart. Two lines of these scarifications are made on the arm to the wrist, care being taken to tabulate each one carefully as it is done, so that no mistake will be made when it is time to read the results. At the end of 25 to 30 minutes each one is cleansed with warm water and cotton, being careful not to rub hard.

If there is any reaction it will, as a rule, be apparent at the end of 30 minutes, though delayed reactions have been reported, some not occurring for over 24 hours. The typical reaction takes the form of an urticarial wheal or white elevation about the site of the scarification. The larger and more irregular in outline it is, the more marked the reaction. At times there is a red areola surrounding it. Lesser reactions occur where the wheal is smaller and quite regular in outline, but these must not be discarded as they are still positive, though to a less extent. Any reaction that measures 0.5 cm. in diameter should be considered positive. The reading of these reactions is by far the most important part of the test, and because some men have been unable to do so they have gotten poor results. It is far better to say that a questionable reaction is positive than to err on the other side and take only the most marked reactions as positive.

Desensitization.—This is accomplished by the hypodermic injection of minute doses of the protein to

which the patient reacts. The initial dose should be so small that no reaction occurs after its administration, this being determined by intradermal or cutaneous tests of solutions of known strength. One finds in this way which strength gives no reaction, and this one is used for the first treatment.

The treatments are given every week, the dose being increased each time. The number of doses varies greatly in individual cases, according, in most instances, to the size of the initial dose that the patient can take.

This method is best used for the pollens and the animal and bacterial proteins, while it does not act well in the case of food proteins. It is better to remove the offending food entirely from the diet for some months at least and then test again, when, if the reaction is less, small amounts of this food should be given at decreasing intervals.

Case Reports.—Medical literature is filled with reports of cases of hay fever, asthma and skin conditions due to protein sensitization, but little has been found therein regarding the gastrointestinal conditions in children; therefore, a few such cases are submitted herewith, those associated with acid intoxication having been reported by M. A. Ramirez (New York Med. Jour., Sept. 21, 1921) and the other by the writer of the present article (Archives of Pediat., May, 1922).

CASE 1.—Male, 2½ years. Attacks of cyclic vomiting and acidosis about every six weeks for one year. Positive reactions to carrot and spinach. These were removed from his diet and in 18 months he has had no return of the attack. He has gained much in weight and strength. Has

recently had influenza and scarlet fever with no bad results and recovered from these diseases more quickly and in better condition than did a sister and brother.

CASE 2.—Female, 3 years. For 8 months, frequent digestive disturbances associated with vomiting and acidosis. Reacted positively to carrots, lettuce and rice. The removal of these foods was followed by absolute relief. Two months after the tests were made, she had soup in which one carrot had been cooked, unknown to her mother, and in two days she had a slight return of vomiting, which lasted only 1 day. Since then there has been no return in the year which has elapsed.

CASE 3.—Female, 2 years. Four attacks of vomiting associated with acidosis, serious in character. Reacted to carrots, pork, barley and rice. For 2 months she had no attack, but while visiting relatives she ate some of the positive foods and 3 days later had an attack of moderate severity; during the succeeding 5 months there has been no return and her health is normal in every respect.

CASE 4.—Male, $3\frac{1}{2}$ years. Always a weak child; poor development, pale, always tired, diarrhea alternating with constipation; abdomen large, much gas, separation of recti muscles—the typical picture of malnutrition. Reacted to beef, barley, corn and plum. In the 6 months following the removal of these foods from his diet there has been no return of his symptoms. He has gained 6 pounds in weight; color good, muscles strong, abdomen normal, and he has lost his irritableness.

CASE 5.—Male, 9 years. Always a sickly, undernourished child, with much difficulty in feeding owing to frequent attacks of indigestion associated with acid intoxication. Reacted positively to tomato, onion, asparagus, squash and beef. The tomato reaction was ++++. It was found that on the evenings preceding the last 2 attacks he had eaten tomato either in soup or as a vegetable, and the symptoms occurred within 12 hours. No attack has occurred in the last 6 months.

CASE 6.—Male, $6\frac{1}{2}$ years. A difficult feeding case since birth. Frequent gastrointestinal upsets associated with acidosis. Positive reactions were obtained to carrot,

peach, plum, fig, squash and tomato. In the year preceding the test he had only gained 1 pound in weight. He has gained 4 pounds in the 5 months since these foods have been removed from his diet.

THEODORE LE BOUTILLIER,
Philadelphia.

PROTEIN THERAPY, NON-SPECIFIC.—Time has severely shaken the theory of strict specificity in its relations to immunity. Even vaccines have departed materially from the beaten path in this direction, non-specific vaccines used in intravenous injections in typhoid fever, for example, having given just as good results as specific vaccines. Proteins, peptones, deuto-albumoses, bacteria, etc., have all shown, by the similarity of their reactions, that non-specificity must be reckoned with in the future. Even Wright had to acknowledge its influence when, in using antipneumococcus inoculations in the Transvaal, he observed, besides a large reduction of the mortality from pneumonia, a reduction of 50 per cent. in the mortality from other infections. Upon this principle is based non-specific protein therapy: a foreign protein, sterile albumose solutions, horse serum, sodium nucleinate, bacterial proteins, or colloidal metals being injected intravenously, and milk intramuscularly, to provoke a reaction of the body's defensive powers.

Physiological Action.—As is the case with all therapeutic measures which involve the defensive processes of the body today, the prevailing theory of immunity explains but few of the phenomena observed, leucocytosis, the appearance in the blood of non-specific proteoses and lipases,

an unduly rapid formation of antibodies, a perversion of defensive ferments, the formation of antiferments, etc., having all been tentatively adduced as possible explanations. This is due to the prevailing ignorance of the defensive functions of the ductless glands, which functions are described in the first volume of the present work and to which the reader is referred (see *ANIMAL EXTRACTS*, Volume I, p. 689 *et seq.*). There has been observed an active proliferation of granular neutrophils and, in some cases, an increase of red corpuscles.

Untoward Effects.—At first, typhoid bacterins were tried intravenously, but their use was often attended by shock with chills, fever, and other untoward symptoms. Other agents likewise produce reactions. Carefully sterilized milk was then tried by intramuscular injection. This proved the least likely to produce a violent reaction, yet caused invariably a rise of temperature of from 2° to 5° F., lasting about twenty-four hours, and an active leucocytosis, a slight rigor with occasionally muscular twitchings, and very rarely shock. An overdose might give rise to cyanosis, dyspnea, shock and diarrhea. Cyanosis and dyspnea were found by Gow to be promptly relieved by the hypodermic use of **adrenalin** or **atropin**.

The unfavorable manifestations that sometimes follow the parenteral use of proteins are as follows: A few minutes after the injection, cyanosis, dyspnea, small pulse, occasionally unconsciousness, transient edema and transient erythema; a few hours after the injection, chills, fever and outbreak of sweat. Cachexia, which may follow the parenteral administration of large amounts of protein, is occasioned by the overproduction of

proteolytic ferments. Van Randenborgh (*Zentralbl. f. Gynäk.*, Oct. 2, 1920).

At Cook County Hospital, Chicago, at least 2,000 intravenous injections of typhoid vaccine were given in the treatment of various acute infections without serious consequences. The only untoward result observed was the development of delirium tremens in confirmed alcoholics. The treatment was not administered to enfeebled patients, nor to those with disturbed heart action. J. L. Miller (*Jour. Amer. Med. Assoc.*, Jan. 29, 1921).

Protein injections have rather an unfavorable action on diabetic acidosis. In the asthenic type of diabetes in young persons there is absence of the thermic reaction to these injections. Insulin treatment restores the ability to react with fever. R. Schmidt (*Med. Klin.*, Nov. 30, 1924).

Mode of Administration.—For intravenous injections, Merck's 4 per cent. albumose solution, giving 1 to 2 c.c. daily, adjusting the dose to that just sufficient to produce a chill, or typhoid vaccine preserved in 0.5 per cent. phenol, or a stock solution, are employed. These, or the intramuscular injections of milk, may be made in the gluteal muscles or in those of the back or arm. The condition, strength and age of the patient should, of course, regulate the dose.

As to the milk injections, the dose varies from 5 to 20 c.c. (1¼ to 5 drams). The severity of the reaction corresponds in a measure with the size of the dose. A second injection may be given after the local and general reactions, including the leucocytosis, have subsided, *i.e.*, in from 2 to 5 days. A carefully aseptitized and graded syringe should be employed. Some authors have used

daily injections where a negative phase does not appear.

It has been shown that no negative phase, so far as the antibody content of the blood is concerned, follows the injection of foreign protein. For this reason daily injections seem justifiable. On the other hand, if the severity of the reaction and the patient's condition are taken into consideration, it is good practice to allow a day to intervene between the injections. If any benefit is to be secured by this method of treatment, from 1 to 10 injections are sufficient. No anaphylactic shock phenomena accompany the injections, even though a second course of treatment may be given after several months. Sterile albumose solutions, horse serum, and bacterial proteins bring about similar results. D. M. Cowie (Jour. Amer. Med. Assoc., Jan. 29, 1921).

Contraindications.—Uncompensated cardiac lesions and acute endocarditis or pericarditis are regarded as contraindications. Renal disorders do not seem to contraindicate the use of sterilized milk, although a slight increase of albumin might suggest the opposite. Even when a few casts also appear, these effects are ephemeral.

Therapeutics.—The injections should be started as soon as possible after the presence of a morbid process or infection is recognized. Chronic cases should be treated with small, gradually increasing doses; acute cases, with maximal doses given at short intervals (Bastron).

In **arthritis**, particularly acute, sub-acute, and peri-arthritis, protein therapy has been efficient, though often evanescently so unless any focus of infection present be removed.

Among 43 cases of varying nature treated with parenteral protein injections, **acute rheumatism** and **acute**

hepatitis showed the best results. In chronic rheumatism there was no benefit. Milk injections proved to be the most effective form of protein therapy. The only contraindication is tuberculosis. Christoffersen and Polack (Ugeskr. f. Laeger, Sept. 10, 1925).

In **typhoid fever** the results have been favorable, irrespective of the kind of foreign protein used, crisis occurring after 1 to 3 intravenous injections in about 20 per cent. of all cases, and rapid lysis in an additional 20 per cent., with noticeable shortening in a third 20 per cent. **Typhus** and **puerperal sepsis** and **pneumococcus** and **influenzal pneumonia** are among the acute infections in which good results have been reported.

The writer tried fresh and boiled milk, including milk from the market which had been boiled 4 minutes. The latter as a rule caused chills, malaise and high transitory fever and locally swelling, sensitiveness and pain. Fresh milk gave similar results, but much milder. One group of 8 cases treated comprised miscellaneous infections—**scarlet fever**, **erysipelas**, **acute rheumatism**, **prostatitis**, **pyelitis**, etc. Save for 2 cases of scarlet fever, the material all showed rapid fall of temperature and subjective improvement. A second group comprised 30 cases of **influenza**. In 16 there followed within 3 days fall of temperature and improvement. In 5 the improvement followed promptly upon the first injection, with recovery after the second injection. Bratt (Hygiea, Mar. 31, 1920).

In **puerperal sepsis** the writer used 10 Gm. (2-½ drams) of Witte's peptone, about 5 c.c. (1-¼ drams) of hot freshly distilled water, and the volume made up to 100 c.c. (3½ ounces). The first dose which may be given intravenously to a septicemic adult is from 8 to 10 c.c. (2 to 2½ drams). The quantity is increased by 2 c.c. (½ dram) every other day or so until 16, 18 or 20 c.c. (4, 4½ or 5 drams)

are given at a time. The injection must be made slowly, using a Record syringe and a very fine bore needle; with a No. 28 it is impossible to introduce the solution too rapidly. The injection tends to cause an immediate and rapid fall in blood-pressure, a rise in pulse frequency, and if the patient has a leucocytosis, it rapidly induces a high degree of peripheral leucopenia—all these phenomena of very short duration. It does not always bring the septicemia to an end. Gow (Brit. Med. Jour., Aug. 21, 1920).

Case of **pernicious anemia** in a man of 38 in which a single milk injection was followed at once by permanent disappearance of fever, diarrhea, hemorrhages, and by marked blood regeneration. There was pronounced improvement in 2 additional cases, and slight benefit in some others. The writer found kefir by the mouth almost equally useful, and suggests that its use may constitute a form of protein therapy through the intestine. Two cases of permanent cure—1 of 8 years' duration—and several of temporary marked improvement under it are reported. K. Faber (Presse méd., Oct. 11, 1922).

The beneficial effect of protein therapy in many patients with **gastric or duodenal ulcer** is undeniable. It seems that functional affections of the digestive apparatus are also well influenced. The writer had good results in **pylorospasm** and **gastric crises**. **Chronic colitis** and **cholecystitis** are also amenable. Combination of thyroid tablets with milk injections and a colon bacillus vaccine was successful in constitutional **obesity**. Mild **diabetes** may be treated with injections of proteins. A tendency to **urate deposits** and **cholesterolemia** are also indications. R. Schmidt (Med. Klin., Nov. 30, 1924).

Protein shock by milk injections induced in 40 cases of **insanity**. Vegetative tone, where previously abnormal, was found to be restored to normal by the procedure. The question arises whether in these cases an enhanced functional activity of the cell protoplasm and the colloid balance of the

body fluids was responsible for the restoration of vegetative tone, or whether the latter effect was primary to the changes in the cells and colloid balance. Obregia, Popea and Giurgiu (C. r. Soc. de biol., Aug. 14, 1925).

Parenteral milk injections seem to give good results in **ophthalmology**, especially in **acute iritis** and other diseases due to local infection.

Parenteral injection of milk has won an important place in the treatment of the eyes. The results of other substances have not been so reliable as with 5 c.c. (1¼ drams) of milk, boiled for 4 minutes. The protein shock that results has proved particularly effectual in **acute iritis**. From the very first injection the pain is relieved. In **gonococcus conjunctivitis**, the secretion declines and local measures are then more effectual, and coincident **vulvo-vaginitis** subsides also. After an operation on the eye, injection of milk is useful in prophylaxis of infection. At the 4th hour the temperature runs up to 38.5 or 40° C. (101.3 to 104° F.) and keeps high for about 2 hours. Next day there are usually a little headache and loss of appetite. The course is generally 3 or 4 injections at intervals of 1 day. Coppez (Médecine, Jan., 1921)

Injection of milk has given surprising curative results in the most severe suppurative lesions of the eye. The quantity injected should not be over 10 c.c. (2½ drams), daily or every other day. Only fresh milk previously heated to boiling for 4 minutes should be used. Three to 5 injections are sufficient in most cases. R. Arganaraz (Semana méd., xxvii, 57, 1921).

Good results from non-specific parenteral therapy are reported in the **arthritides**, including isolated cases of **gonorrheal** and **tuberculous joint disease**, and **chronic types of arthritis with deformity**. Brilliant results have been obtained in **local infections**, and favorable ones in **inflammatory skin diseases**; in certain gynecologic conditions, such as **adnexitis** and **postpartum fever**, and in diseases of the eye, especially

corneal ulcer, iridocyclitis, and keratitis. Uncertainty exists as to its value in infectious diseases. The dosage should be individualized and the optimal reaction determined by experience. Bastron (Neb. State Med. Jour., Feb., 1923).

The intragluteal injection of milk has given good results in **gonorrheal arthritis**, both subacute and chronic, the improvement depending, however, upon the intensity of the reaction. The acute cases are less advantageously influenced. R. Müller has recorded favorable results in 60 cases of **epididymitis** and in **bubo**.

In a military cantonment where intravenous injections of gonococcal protein were used in **gonococcal epididymitis** the results were most gratifying. Pain usually ceased within 24 hours after a properly reacting protein injection, and the average stay in the hospital was 5 or 6 days. There was usually a marked reduction of the local swelling. In some cases a second injection was required. H. Culver (Jour. Amer. Med. Assoc., Jan. 29, 1921).

Various cutaneous diseases of a chronic type, notably **psoriasis**, **eczema** and **pyogenic disorders** of various types, **impetigo contagiosa**, **trichophytosis**, and **fungoid disorders**, have also been favorably influenced.

In **tuberculosis**, hypodermic or intradermal injection of cow's milk may produce the same pathologic and therapeutic reactions as tuberculin. In most cases of **chronic non-contagious infections** the patients possess a variable degree of anaphylactic hypersensitivity capable of being evoked by any antigenic substance. Several cases of **asthma** of different origin were all cured by a vaccine prepared with the normal bacterial flora of the intestine. It was not essential to induce a "shock" in order to obtain a satisfactory therapeutic result. A stock vaccine of a mixture of the bacteria normally pre-

sent in the intestine gave the same results as an autogenous vaccine. Dilutions representing only 0.001-0.00001 of a mgm. of dry substance proved sufficient dosage. The vaccine was heated several times to 100° C. instead of 60 to 65° and given in but 0.1 or 0.05 c.c. of liquid, to avoid the reactions which even pure physiologic salt solution sometimes produces in hypersensitive individuals. Even these small doses may cause slight reactions in **asthma**, **urticaria**, **eczema**, etc., but they prove generally quite as efficient as the much stronger shock-producing doses. Danysz (Presse méd., July 19, 1924).

Intradermal injection of proteins such as milk in **eczema** gave better results than the same protein given subcutaneously. Ambrosoli (Giorn. ital. d. mal. ven. e d. pelle, Apr., 1924).

As is pointed out in the corresponding articles in this work, **urticaria** and attacks of **asthma** and **migraine** are traceable to hypersensitiveness of various nerve cells or centers to certain protein substances. According to Widal, Abrami, and Brissaud, oral use of peptone is valuable as a prophylactic against these acute attacks.

Giving peptone by the mouth is a very simple harmless method of warding off attacks of **urticaria**, **migraine**, or **asthma**, annulling the action of the unknown substances responsible for their development. Complete desensitization may be obtained by prolonged use of the peptone. If this fails, other proteins might be tried by subcutaneous injection, or even certain crystalloid substances with which the writers have been successful. Widal, Abrami and Brissaud (Presse méd., Mar. 5, 1921).

The writer advocates use of the Armour No. 2 peptone, in a maximum dosage of 2 to 2½ c.c. (32 to 40 minims) of a 5 per cent. solution, intramuscularly or intravenously. Witte's peptone is valuable in certain cases, owing to the nature of its proteoses, but is best given diluted with a weaker peptone. A satisfactory immunizing pro-

cess is characterized by a slight leucocytosis, particularly involving the large mononuclears, and by an increase in the hemoglobin and red cells. A. G. Auld (Brit. Med. Jour., May 27, 1922).

C. E. DE M. SAJOUS,
Philadelphia.

PRURIGO (Juckblattern; Strophulus pruriginex).—Prurigo is a chronic disease showing small, pale or reddish and isolated, deeply seated, or slightly elevated papules, accompanied with intolerable itching, thickening and pigmentation.

Two types are distinguished—*prurigo ferox* (severe prurigo) and *prurigo mitis* (mild prurigo)—according to the severity of the disease. The disease usually begins in the first year of life, sometimes simulating urticaria. Later, discrete, firm papules, pinhead in size, or larger, appear upon the extensor surfaces of the extremities, the trunk, and sometimes upon the forehead, being either pale red or the color of the skin. As a result of the intense itching, the affected areas become covered with scratches and blood-crusts. Later the skin becomes harsh, dry, much thickened, and occasionally pigmented. Exaggeration of the natural furrows of the skin, as a rule, follows. There is an enlargement of the neighboring lymphatic glands. The disease is very rebellious to treatment and may persist throughout an entire lifetime. The disease is very rarely seen in the United States except in immigrants, chiefly in those from Austria.

ETIOLOGY AND PATHOLOGY.—

This disease is the result of poor food and bad hygiene, and is generally limited to the poorer classes. Tuberculosis has been named as a causative factor.

The minute changes are those of a chronic inflammation and are almost identical with those of chronic papular eczema.

Excessive ingestion of sugar or, less frequently, of some other food, may be a cause of prurigo in children. Soft boiled eggs are less readily borne than hard boiled eggs. In some cases irritation by insects is the exciting cause. Weigert (Monat. f. Kind., Mar., 1923).

TREATMENT.—This should be directed toward the relief of the itching,

the cure of the eruption, and the improvement of the general health. For the relief of the itching Crocker recommended **tincture of cannabis**, beginning with 5-minim (0.30 c.c.) doses in a child of 8 years, and increasing to the physiological limit. **Ointments of betanaphthol** (2 to 10 per cent.), of **sulphur** (1:8), and of **tar** (50 per cent.) are also used for the itching. **Wilkinson's ointment** (unguentum sulphuris comp., N. F.) is valuable. In 8 children Dobrowsky observed that **thyroid gland** relieved the itching and cured the eruption. **Baths** exert a favorable influence—the **alkaline bath**: **sodium bicarbonate**, 4 ounces (125 Gm.) to 30 gallons (120 liters) of water,—and the **sulphur bath**,—**precipitated sulphur** or **potassium sulphide**, 4 ounces (125 Gm.) to 30 gallons (120 liters) of water.

Nutritious food and **proper hygiene**, with **tonics** (**iron**, **codliver oil**, and the **hypophosphites**), are indicated. In this disease arsenic has little or no value.

Evidences suggesting a hemoplastic crisis were observed following ingestion of milk or other substances in 16 cases of prurigo. Good therapeutic effects followed the taking of **peptone**, 0.005 Gm. ($\frac{1}{12}$ grain), 1 hour before meals. Brack (Klin. Woch., Oct. 14, 1924).

PRURITUS.—Pruritus is a functional cutaneous disorder, a form of perverted cutaneous sensation, characterized by an itching, tingling, burning, creeping or pricking sensation without structural alteration of the parts. The itching of pruritus is the essential feature, and is not related to any primary cutaneous lesion. It is a distinct affection and must not be confounded with prurigo or any other disease of which itching is one of the many symptoms.

SYNONYMS.—Itching of the skin, paræsthesia.

SYMPTOMS.—The primary symptoms are entirely subjective; of these the first and only one may be the sensation of itching, pricking, formication, or boring, the intensity of which varies within wide limits. It may be slight and transitory, or it may be so severe and persistent as to render life almost unbearable. Waugh

cites a case in which a man walked into his office, laid a revolver on the table, and remarked that he would shoot himself then and there if the physician did not relieve him of his pruritus (anal). Pruritus may be intermittent or constant, general or local; in most cases it comes on in paroxysms, but in the worst cases it is almost constant. It often comes on when the patient is warmed up in bed, and may interfere with sleep. It attacks the skin or the mucocutaneous orifices. In old persons it is prone to appear on the trunk or extremities, in the axillæ, the anus, or the vulva. Not infrequently it affects the legs from the knees to the ankles. Winter pruritus (*P. hiemalis*) especially favors the inside of the thighs. In the effort to obtain relief by rubbing, scratching, or pounding the parts, secondary lesions of the skin are produced.

The secondary cutaneous lesions from the scratching, rubbing, etc., are erythema, roughness, abrasions, lymph-papules and linear wounds showing the track of the nails (Shoemaker). An eczema is not infrequently produced which masks the underlying condition (Schamberg).

VARIETIES.—When the itching is generalized it is called *pruritus universalis*, although it seldom affects the entire cutaneous surface. Diffuse itching is most frequently met with in old persons whose skin is the seat of incipient senile changes; it is then called *pruritus senilis*. Examples of localized itching are seen in *pruritus ani*, *pruritus scroti*, and *pruritus vulvæ*. In the latter the scratching and the pleasurable relief following may pave the way to masturbation. A form of this disorder occurring in the cold weather is called *pruritus hiemalis*, or winter itch. In young adults with dry skin itching sometimes appears after bathing (bath pruritus).

DIAGNOSIS.—Care must be exercised in the diagnosis of this disorder, as many of its morbid sensations resemble those in other cutaneous affections. Of chief importance in the diagnosis are the history of the case, an irritation without any initial eruption, and, perhaps, the appearance, later, of secondary changes—excoriations, crusts, an infiltrated and reddened skin with congested and torn follicles. It may be difficult, when eczema or derma-

titis are complications, to fix upon the primary ailment, especially in the localized forms of pruritus, and one must rely upon the history and subjective symptoms.

Prurigo is sometimes confounded with, or is indeed, at times, called pruritus; but, although it is a source of itching, it is a papular affection, and runs a different course from that of pruritus.

Pediculosis, urticaria, eczema, especially when mild, scabies, ringworms, etc., must be differentiated by the history of the case and by careful examination. One of the rare symptoms of locomotor ataxia is periodical pruritus limited to the lower limbs; the attacks are fugitive, lasting two or three days, and are relieved by hypodermic injections of morphine. With this pruritus of locomotor ataxia are observed inco-ordination of the lower extremities, loss of reflexes, Argyll-Robertson pupils, vesicular paralysis, gastric crises, and other pathognomonic symptoms.

ETIOLOGY AND PATHOLOGY.—

Pruritus, or paresthesia, is usually a functional disorder of the sensory nerves of the skin; it may be caused by functional or organic nervous disease, or by nutritive or metabolic disorders, through their action on the sensory nerves, a hyperesthesia being induced. Among the acknowledged causes of pruritus are the various psychic neuroses, neurasthenia, the uric acid diathesis, diabetes, Bright's disease, utero-ovarian disorders, pregnancy, indigestion, constipation, and hepatic disorders; tobacco, coffee, tea, opium, alcohol; etc., if excessively used, may be etiological factors.

Degenerative cutaneous changes in the aged are an accredited cause of senile pruritus. Pruritus ani is generally due to a local irritation from hemorrhoids, fistula, fissure, or intestinal worms, and less often to constipation, lithemia, etc. Pruritus scroti is very common among tailors, whose cross-legged position at work favors congestion of the parts; by reflex action vesical calculus and urethral stricture have been responsible. Pruritus vulvæ may result from uterine disease, pregnancy, and from leucorrheal and other discharges; it is very frequently present in diabetics. The pruritic habit may be left after eczema and pediculosis have disap-

peared. The action of cold on the peripheral nerves produces pruritus hiemalis in susceptible persons.

PROGNOSIS.—This is good when the cause can be removed. Many patients are cured, although the duration of the disease may be rather long; considerable relief can be given in nearly all cases.

TREATMENT.—The first indication is to remove the cause if possible. *Internal treatment* against any underlying disease—diabetes, lithemia, hepatic and digestive disorders, endocrin disturbance, nervous debility, etc.—will here be necessary. Opium should be avoided, but good results have followed the use of **sodium salicylate**, **phenol**, **acetphenetidin**, **antipyrin**, **chloral**, **bromides**, **ammonium valerate**, **tincture of gelsemium** in ascending doses, etc. Kroner advocates **atropine** and **calcium** preparations.

The use of **woolen undergarments** should be avoided unless a thin cotton garment is worn underneath; **linen** or **silk underwear** is best.

Change of food, climate (warm), and scene are often effective in intractable cases. **Electricity**, **massage**, and **baths** at various temperatures or medicated (emollient, alkaline, **naphthol**, **alum**, **tannin**, **potassium sulphide**, etc.), are useful; the bath should be taken just before retiring for the night. **Turkish**, **vapor**, **electro-vapor** and **medicated vapor baths** of **sulphur**, **mercury**, **tar**, and of the **balsams**, are beneficial.

Locally, agents that have an anesthetic or soothing action give much relief. **Menthol** alone, or triturated with an equal portion of **camphor**, is the favorite remedy with many, and may be used in solution or in ointment. Stelwagon suggested **menthol**, **camphor** and **phenol**, 10 to 15 grains (0.6 to 1 Gm.) of each to the ounce (30 Gm.) of **benzoinated lard**. Bulkley advises **chloral** and **camphor**, $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) of each to an ounce (30 Gm.) of **rose-water ointment**. Bronson favors an oily application—**phenol** and **liquor potassii hydroxidi**, 1 dram (4 Gm.) of each to an ounce (30 c.c.) of **linseed oil**. Crocker suggested a thymol lotion—**thymol**, 2 drams (8 Gm.); **liquor potassii hydroxidi**, 1 dram (4 c.c.); **glycerin**, 3 drams (12 c.c.), added to 8 ounces (250 c.c.) of water.

Cider vinegar has been advocated, and

also **sodium carbonate** (washing soda), 1 dram (4 Gm.) to the pint (500 c.c.) of water. Liveing's favorite ointment was: **Morphine hydrochloride**, 2 grains (0.13 Gm.); **bismuth subnitrate**, 1 dram (4 Gm.), and **rose-water ointment**, 1 ounce (30 Gm.), mixed.

In stubborn cases the writer had good results from intravenous injection of **Ringer's solution**, 60 to 250 c.c. (2 ounces to $\frac{1}{2}$ pint), at room temperature. When the larger amounts were used, **venesection** followed by an infusion was preferred. J. W. Miller (Ohio State Med. Jour., Dec., 1924).

Excellent effects from **sodium** or **calcium bromide** intravenously in refractory pruritus, as well as in Hegar's prurigo. Felugo (Giorn. ital. di dermat. e sifil., June, 1925).

Pruritus senilis is often relieved by an ointment of 1 part of the **oil of staphisagria** (stavesacre) to 7 parts of lard. **Phenol**, **creolin**, **creosote**, and **tartaric acid**, 1 to 20 parts of **glycerite of starch**, may also be availed of.

A well-fitting **suspensory** is advised in pruritus scroti; in obstinate cases of the latter, as well as in pruritus ani and vulvæ, Schamberg has obtained brilliant results from the use of the **X-rays**. Others have advocated the **ultra-violet rays**.

High-frequency currents are beneficial in localized pruritus. W.

PSEUDOLEUKEMIA. See LEUKEMIA AND PSEUDOLEUKEMIA.

PSILOSIS, OR SPRUE. See INTESTINES, DISEASES OF; AND MOUTH: PARASITIC STOMATITIS.

PSITTACOSIS.—DEFINITION.—An epidemic disorder of parrots, transmissible to man and featured in the latter by symptoms suggestive of typhoid fever, usually complicated by pneumonia.

SYMPTOMS.—After an incubation period of 7 to 12 or more days, the disease commonly sets in insidiously with lassitude, malaise, headache, nausea, constipation, and sometimes photophobia. In a minority of instances a chill marks the onset. The temperature now rises rapidly, as a rule, to 102 to 104° F. (38.9 to 40° C.), with a pulse-

rate of 100 to 120. Quickened breathing, cough, and mucopurulent or bloody expectoration are noticed, and fine râles may be heard over the lungs. Typhoid fever is simulated by enlargement of the spleen and rose-colored spots. A dry, coated tongue is seen, and frequently there is diarrhea; less often, constipation. The fever shows daily remissions. Mental dullness or stupor, with some delirium, may be present for several days. The disease runs its course in 15 to 20 days and is usually followed by recovery where pneumonia does not complicate it; if, however, pneumonia develops, early aggravation and generally a fatal ending ensue. The mortality, as a whole, is placed at 35 to 40 per cent.; it is higher in elderly subjects than in the young.

ETIOLOGY.—The disorder is ascribed to *Bacillus psittacosis*, first isolated from dead parrots' wings and bone-marrow by Nocard in 1893, and by Gilbert and Fournier in 1897 from the intestine of the diseased birds as well as from the heart-blood of a human victim. This bacillus is held to be closely related to *B. paratyphosus* and the salmonella group, and is believed by French authors to pave the way for secondary infection of the lungs with other organisms. Some have been unable to isolate the *B. psittacosis* from human cases. The mouth and bill of the diseased birds become infected through cleaning with the tongue of the feathers soiled with fecal matter.

House epidemics of psittacosis, ascribed to infection from a sick parrot, have occurred in various countries of Europe and in America. In 1892, no less than 49 cases and 16 deaths occurred in Paris through infection from a South American shipment of parrots, many of which had died on the way. Infected parrots appear always to have come from South America.

PATHOLOGY.—The chief postmortem features observed in man have been those of pneumonia, together with other evidences significant of a general infection, the condition being regarded as of a septicemic type. In the parrot, there is no pulmonary involvement, the pathological changes being those of a severe enteritis, with cloudy swelling or fatty degeneration of some of the other viscera.

DIAGNOSIS.—This is apt to be difficult, unless the relationship of one or more sick

parrots to human beings suffering from typhoid-like fevers with atypical pneumonia can be made out. The disease in parrots is characterized mainly by enteritis, anorexia and weakness. Typhoid fever in man can be differentiated by the Widal test and characteristic blood findings, croupous pneumonia by the lobar type of consolidation, and influenza, with which the disease has not infrequently been confounded, by the greater prominence of symptoms in the upper respiratory tract.

Isolation of the *B. psittacosis* by blood culture may be tried.

PROPHYLAXIS.—This comprises the quarantining of newly-arrived parrots and destruction of those found infected; cleanliness and proper hygiene of parrots kept in captivity; the steaming of infected cages; the avoidance of all contact with sick parrots, and the isolation of human patients.

TREATMENT.—No effective remedies being known, the treatment is a combination of the symptomatic measures appropriate in typhoid fever and pneumonia. **Cold sponging** may be employed for high temperatures. Where constipation exists, an initial **purge** may be given, to be followed by **enemas** or further catharsis as indicated. The **diet** should be of the supportive, yet easily digested type. **Stimulants** are in many instances required. S.

PSORIASIS.—DEFINITION.—

Psoriasis is a cutaneous disease characterized by the presence of silvery-white, perfectly dry scales, which overlie a reddish, shining base.

SYMPTOMS.—The eruption of psoriasis is always dry and scaly. It begins in one or more red points, which quickly become covered with white, silvery scales. These may be readily scratched off by the finger-nail, and when this is done a bleeding surface is exposed. When many of these small, scaly lesions are present, the eruption is described as *punctate psoriasis*, and this form of the eruption is comparatively more frequent in children than in adults; when the scaly lesions increase in size and appear like drops of grease or thin mortar spattered over the skin, we have the *guttate form* of the disease; and when the patches assume the size and shape of silver coins, they are often de-

scribed as *nummular psoriasis*. By healing in the center these lesions may be converted into scaly rings, or by peripheral increase and coalescence they may result in the formation of extensive scaly patches.

Though the disease is not uncommonly met in children, diffused or general psoriasis is rarely met with among them. It is not generally so well developed and so extensive as it is apt to be in later years. The amount of scaliness present in any case depends upon the attention which the patient naturally devotes to his skin. As the eruption tends to disappear, the scaling grows less, often disappearing from the center of the patch and leaving a marginate ring. Finally the redness fades and the skin assumes a normal appearance, except in certain cases, where pigmentation may occur. In rare cases of psoriasis the eruption may tend to rapidly involve the whole skin. The cutaneous congestion is severe, and large flakes of partly detached epidermis may take the place of the silvery scales.

Psoriasis is usually seen upon the extensor surface of the extremities, and is especially apt to be noted about the elbows and knees. When upon the scalp the scaly patches are apt to be small, numerous, and circular, with healthy skin intervening. The eruption upon one extremity or on one side of the trunk is usually duplicated upon the other side (Fox).

Pruritus may or may not be complained of, and the patients may be in apparently good health. Disorders of the muscles and joints are often noted, however.

DIAGNOSIS.—The diagnosis of psoriasis, as a rule, presents no difficulties; the silvery-white, perfectly dry scales are altogether characteristic. Upon the scalp it may be confounded with *seborrhea*, but the absence of inflammatory reddening and the greasy character of the scales in the latter affection will serve to distinguish it from the former.

Whether occurring in small disks or in large, irregular patches, the border in psoriasis is always sharply defined, and never shades off gradually into the surrounding healthy skin, as does the ordinary patch of *eczema*. This is a diagnostic point of great importance. In many cases

of *eczema* the patches may be dry and scaly and present a resemblance to those of psoriasis, but the rounded, silvery disks or larger marginate patches of the latter disease are usually so characteristic that an error in diagnosis is not likely to be made. While *eczema* may appear upon almost any part of the body, and often exhibits a tendency to attack the flexor aspect of the joints and other parts where the skin is thin and delicate, psoriasis, as stated, is generally seen upon the extensor surface of the extremities, and is especially apt to be noted about the elbows and knees.

An eruption resembling psoriasis sometimes occurs in *syphilis*, but the successive crops and the coalescence of lesions in psoriasis serve to distinguish it.

ETIOLOGY AND PATHOGENESIS.

—Psoriasis occurs somewhat more frequently in males than in females, and at all ages, but it is most frequently met with in subjects between 10 and 30 years of age, though it is by no means rare in infancy.

Psoriasis is essentially a chronic disease. It is not a local disorder, but depends upon a general condition, which repeatedly produces the eruption.

Psoriasis of the palm is occasionally met with in cases of acquired syphilis, but usually this is observed, according to Hutchinson, in individuals whose hands are more or less irritated by friction.

A tendency to psoriasis is frequently inherited, and very often the disease may be observed in two or more generations.

Seasons seem to have some influence upon the disease, since in spring and autumn the disease often takes on an increased vigor.

Although fungi, micrococci, and other organisms have been incriminated, none showing ubiquitous specificity have been satisfactorily demonstrated. This does not mean that pathogenic organisms may not provoke the disease. The neuropathic theory has also received considerable attention; but the observations which have been adduced in favor of this theory appear to me accountable in another way—one, indeed, which also accounts for the pathogenic rôle of micro-organisms in the disease.

And,

R Arseni trioxidi 0.5 Gm. (7½ gr.).
Pulveris piperis 6.0 Gm. (1½ dr.).
Acacia,
Althea,
Aqua destillata... āā q. s.

Fiant pilulæ no. 100.

Sig.: Three to ten daily after meals.

To these measures are added plenty of **fresh air and rest**. The **diet** should be bland; **meat** should be **interdicted**, at least for a time.

Alcohol applied at night with cotton compresses is very effective, according to Lau. The alcohol used varies from 70 to 90 per cent. and contains 2 per cent. of **salicylic acid**. A rubber dam or other impervious material should be used to prevent evaporation. Next morning the parts are washed with soap and the loosened scales removed. The parts are then anointed with lanolin. This method of treatment is cleanly and gives the patient no annoyance.

Pilocarpine is found useful in some cases. As observed by Herxheimer and Köster, an intramuscular injection of 0.01 Gm. (¼ grain) of pilocarpine hydrochloride is followed in 5 minutes by free perspiration and a flow of **saliva**. The injections are repeated at intervals of 2 or 3 days, and after the 6th injection the eruption almost completely disappears.

The **X-rays** have been found of great value in chronic cases.

One hundred cases of universal psoriasis successfully treated with the **X-rays**. Exposures are preferably given 3 times a week. At the first treatment, the head and arms are exposed; the second, the trunk and buttocks, and the third, the legs and thighs. The complete course takes 4 to 8 weeks. Remer and Witherbee (Med. Rec., Aug. 28, 1920).

The writer applied the **X-rays** to the **thymus gland** in 82 psoriatic patients. Good results followed in 66 per cent., but recurrence took place more frequently than after local raying of the patches of eruption. K. Gawalowski (Ceska Dermatol., iv, 94, 1923).

Under the **mercury quartz lamp**, psoriasis clears up more effectively than under any other treatment ex-

cept the **X-rays**. The writer, however, prefers the former; recurrences are longer delayed after successful **ultra-violet light** treatment. It is safer and more desirable when the scalp is involved. H. E. Alderson (Arch. of Derm. and Syph., July, 1923).

Complete cure in 85 per cent. of cases of psoriasis can be had with the **X-ray** alone, provided the patient coöperates fully. J. O. Parker (Jour. of Radiol., Oct., 1925).

Autoserum has been lauded by various authors, but others have not found it effectual unless used with local agents of known value. A suitable quantity of blood is drawn and centrifuged and the serum obtained injected intravenously. Gotthell gave 3 or 4 weekly injections of from 20 to 30 c.c. each, before beginning a mild local treatment. Fox considers autogenous serum of decided value in many cases when used in conjunction with **chrysarobin**. Similar results have been observed by Scully from intravenous injections of 75 to 100 million **killed typhoid organisms** at 3 or 4-day intervals.

Case of extensive psoriasis with prompt and complete recovery under protein shock treatment, 20 c.c. of **normal horse serum** being injected into the abdominal wall. Fever followed for 5 days. A few days later the eruption had practically disappeared. C. de-Rezende (Brazil-med., July 3, 1920).

The most essential principle in the treatment is the conversion of the active into an inactive or quiescent stage. The previously ineffectual remedies then become effective. One measure that tends to bring about a subsidence of the psoriatic process is a **low protein diet**, i.e., one containing about 4 Gm. of nitrogen a day. Other therapeutic agencies that have been employed include the **intravenous injection of vegetable proteins**, the injection of an **enterovaccine** containing chiefly the **fecal streptococcus** and **colon bacillus**, the subcutaneous or intravenous injection of a **typhoid** or **colon bacillus vaccine**, and finally, **autoserum injections** which tend to inactivate psoriasis and aid in bringing about a state of quiescence.

All other procedures induce a leukocytosis, proportionate in large part to the degree of reaction evoked. During this stage the **X-rays**, **chrysarobin** and other measures promptly effect a disappearance of the eruption. Schamberg (Jour. Amer. Med. Assoc., Oct. 18, 1924).

The use of **thyroid gland** in psoriasis has not, on the whole, given satisfaction, although great improvement has been noted in certain cases. (See **THYROID GLAND** in the article on **ANIMAL EXTRACTS**, Vol. I). As a rule, however, the doses used have been too large. Such doses so stimulate catabolism that they cause an accumulation of wastes in the blood, and thus favor continuance of the disease. From 1 to 2 grains (0.065 to 0.13 Gm.) of thyroid three times daily should not be exceeded in these cases.

Case of long standing psoriasis and amenorrhea in which both conditions were relieved by **ovarian extract**. The patient was well 18 months later. Verrotti (Gior. ital. d. mal. ven. e d. pelle, No. 3, 447, 1920).

Disappearance of the disease observed under intramuscular **injections of thymus extract**. The dosage began with 1 c.c., corresponding to 1 Gm. of thymus, and then ascended so that a total of 20 or 30 Gm. of thymus was given in 8 to 14 injections. B. G. Gross (Deut. med. Woch., Sept. 8, 1922).

Brocq has described under the appellation *parapsoriasis*—with 3 subdivisions: guttata, lichenoides, and in patches—a group of cases variously simulating psoriasis, lichen planus, and seborrheic eczema, and featured by an almost complete absence of itching, a slow course, well-defined patches (2 to 6 cm.), paucity of dermal infiltration, pale red color, fine desquamation, and resistance to local treatment. Some of these cases have at times been considered as an atypical skin tuberculosis. The treatment is that of psoriasis, but even vigorous applications of **pyrogallol** have often failed to yield much benefit, the condition being more refractory than psoriasis. In a case reported by D. E. Cohen, however, great improvement followed intramuscular injections of **pilocarpine**. S.

PSYCHOSES AND THE INTERNAL SECRETIONS.—The foregoing title indicates the purpose of this article. It aims to show that the endocrin organs afford a field of study which will prove of considerable assistance in the elucidation of the pathogenesis of mental diseases, especially the manner in which the brain functions are perverted and the processes through which these perversions evoke morbid symptoms. As matters stand today, the relations between cause and effect are not understood. Symptoms, their supposed exciting cause, and the lesions in the cerebral structures, if any, are noted, but the *manner* in which they are produced is hardly taken into account. This is due to absence of the fundamental link which the endocrins afford, since, as we shall see presently, it is through these organs, or rather their secretions, that the cerebral neurons are kept vitally active and free of foreign substances, toxins, and wastes which in many psychoses initiate the active morbid phenomena. As shown in the illustration opposite page 674, the nerve cell or neuron is a complex organ, but one in which the functional constituents of all other tissue-cells are found. Such being the case, it is plain that a deficiency or excess of the endocrin secretions will correspondingly accelerate or slow the intrinsic metabolism of these neurons, and thus awaken phenomena of mental excitability or depression as the case may be.

In order to render these conceptions intelligible, however, it is necessary to review briefly my own interpretation of the endocrins in their relation to the brain. This is inevitable

because of the chaotic state of endocrinology as it is generally interpreted at the present time, which makes it impossible to analyze logically any of the questions in point. This is due to the fact that to this day experimenters have been unable to identify the fundamental functions of any ductless gland.

The present (1927) status of the knowledge concerning the fundamental functions of these organs is well illustrated by the sworn statement of Prof. Woodyatt, of the University of Chicago, during the Leopold and Loeb trial in 1925, that the present knowledge of the internal secretions could be compared "to Darkest Africa before Stanley went in."

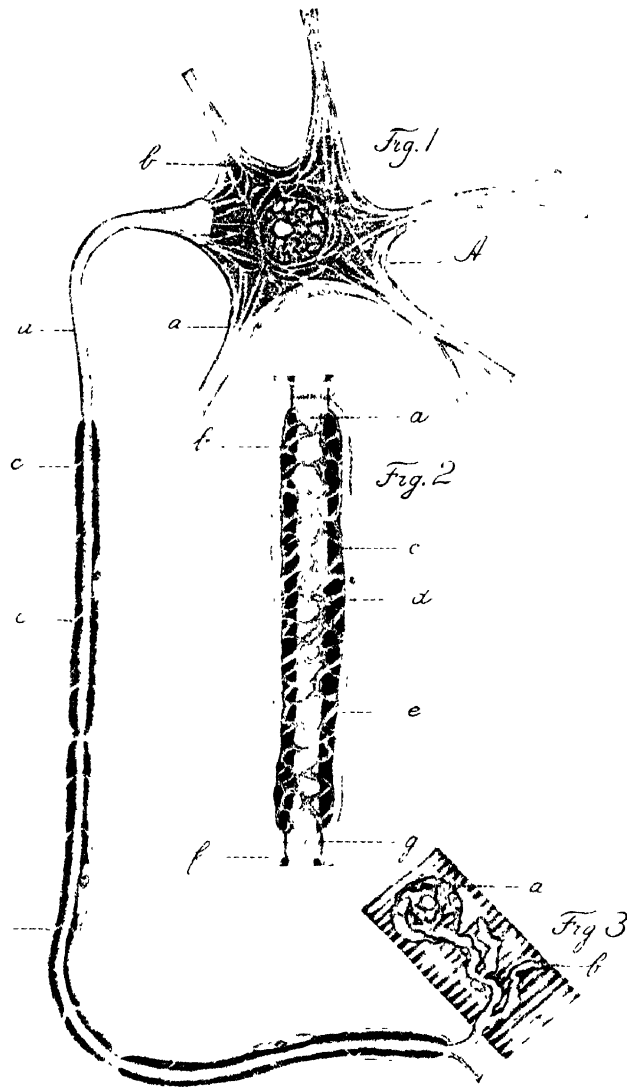
Special workers in the endocrinological field are no less explicit. This was shown by a series of articles published towards the end of 1924 in the *Journal of the American Medical Association*. Concerning the thyroid, Reid Hunt (*Jour. Amer. Med. Assoc.*, lxxxiii, 1244, 1924) held that "the mode of action of iodine in the thyroid is not known." Boothby and Plummer (*ibid.*, lxxxiii, 1333, 1924) also wrote that "the exact physiochemical status of thyroxin as it leaves the thyroid is not known." As to the adrenals, Hooker (*ibid.*, lxxxiii, 1430, 1924) declared that "epinephrin is not essential to life," and that while the cortex is, "nothing is known definitely about its physiology." Concerning the pituitary body, Howell (*ibid.*, lxxxiii, 1684, 1924), of Johns Hopkins, recalling that French and American investigators had obtained results attributed to its "supposed secretion" by causing lesions above this organ, questioned the validity of present teachings. Swale Vincent ("Internal Secretions and Ductless Glands," 1924, p. 399), of London University, alluding to these experiments in the last edition of his book, also pointed to the need of "a reconsideration of our whole attitude in relation to the pituitary body." Macallum (*Jour. Amer. Med. Assoc.*, lxxxiii, 1846, 1924) denied precise knowledge of the different functions of the various cells in the parathyroids and questioned the soundness of the methylguanidin theory as a cause of tetany. As to the ovaries, Carlson (*ibid.*, lxxxiii, 1920,

1924) recalled that none of the various hormones had been isolated and expressed doubt as to whether "any of the ovarian functions could be maintained by substitution therapy." The other endocrins, including the thymus, generally deemed of negligible import, were ignored. Books published during the year 1926 as vividly portrayed the same confused state of the subject as a whole.

Conversely, my own views, based on a collective study of all branches of science as now recognized by various authors, including Dr. Geo. W. Crile, have stood the test of time, the mass of experimental and clinical evidence on record, sterile in all directions, having found a ready nidus in my own interpretations. Hence their adoption in the present connection.

The annexed plate affords a schematic outline of a nerve cell or neuron, prepared by grouping histological microphotographs and designs. It indicates, from my viewpoint, that each nerve cell is an individual structure—an organ. The location of the various functional agents in the star-like cell body, Fig. 1, and its axon, or nerve, a detailed though shortened segment of which is shown in Fig. 2, is indicated by letters repeated in each figure. Thus, *a* points to axis-cylinders, which are *adrenoxidase* channels, while *b* indicates the myelin channels, rich in *lecithin* and *cholesterol*. Fig. 3 illustrates a muscular nerve-ending, which the adrenal medullary product, as represented by epinephrin or adrenalin, stimulates when administered therapeutically. The plate itself shows a more detailed description of the neural structures.

We have seen that these various chemical agents are present in all the tissues of the body. It thus becomes apparent that the functions of the



THE NEURON AS AN ORGAN (Sajous)

Fig. 1. CELL BODY OR CHIEF CELL. *A*, *a*, fibrils as capillaries for adrenoxidase-plasma; *b*, Nissl granules, as nucleo-proteid (lecithin) microsomes.

Fig. 2. TRUE NERVE-CELL. *a*, axis-cylinder fibrils as capillaries for adrenoxidase-plasma; *b*, network for distribution of plasma throughout myelin; *c*, myelin containing lecithin and cholesterol; *d*, cell-nucleus and nucleolus; *e*, neurilemma; *f*, tip of next cell; *g*, Ranvier's node. In cells on neuron: *c*, slits of Lautermann.

Fig. 3. MUSCULAR TISSUE. *a*, motor ending; *b*, terminals of fibrils of axis-cylinder, in which adrenoxidase-plasma flows upward or centripetally.

nervous system are carried on precisely as they are in all tissues. The lecithin (cephalin in the brain cells), the thermogenic phospholipoid, is oxidized by the oxidizing enzyme *adrenoxidase* to liberate heat energy. This reaction is kept within safe physiological bounds by the *cholesterol*, which tends to lower the sensitiveness or lability of the lecithin to oxidation, or inhibit it; while, conversely, the thyroparathyroid hormone merged in with the blood supplied to the nerve cells serves to increase the sensitiveness of the lecithin to oxidation. By thus sustaining heat production and regulating it, these various agents, by slowing or accelerating their action as need be, govern what in reality sustains life itself in all tissue cells, *their enzymes*. Indeed, as Mendel has so well expressed it: "Enzymes are no longer thought of exclusively as agents of the digestive apparatus; they enter everywhere into the manifold activity of cells in almost every feature of metabolism."

THE ENDOCRINS IN THE GENERAL PATHOGENESIS OF THE PSYCHOSES.—The rôle of the endocrin organs in the various psychoses differs in no way from that carried out in any other disease. They collectively carry on the processes which maintain tissue life by sustaining heat production and its activating influence upon all enzymic functions in metabolism and active defense.

While insanity has been defined as a departure from a normal standard of thinking and feeling, no mental conception or psychical manifestation can occur except through the medium of the brain. We are brought, therefore, to consider impaired nutri-

tion, circulatory variations, toxemias, or structural changes in this organ as the underlying cause of psychoses.

A connection between the function of the ductless glands and diseases of the mind has long been thought to exist, the mental disturbances often witnessed in Addison's disease, myxedema, Graves's disease, reviewed under their respective headings in this work, having attracted attention in this direction. French clinicians, Sergent and Bernard, Boinet, Laiguel-Lavastine and many others, have studied these mental complications and have in fact erected syndromes of psychoses based on disordered functions of these organs. Owing, however, to the prevailing lack of knowledge concerning their functions, the pathogenetic relationship between them and mental disorders has remained obscure. The observers mentioned took, for instance, no account of lecithin, cholesterol, or *adrenoxidase*—the main active agents not only in the pathogenesis of mental disorders, but also in their treatment, as we shall see.

A succinct summary of the psychoses which occur in the course of severe diseases of the endocrin organs will emphasize the influence of their biochemical products in the pathogenesis of the abnormal mental phenomena they can produce. It is not, however, only in these endocrin diseases that the biochemical agents of endocrin origin awaken psychoses, but also, from my viewpoint, in mental disorders which to this day have not been associated by other investigators with the endocrin organs, directly or indirectly.

THE THYROID GLAND IN PSYCHOSES.—*Graves's disease*, as is well known, frequently gives rise to

mental disorders. Here the underlying cause is a *toxemia* due either to the accumulation in the blood of toxins from some focal or general infection, or to catabolic wastes resulting from the excessive activity of the thyroid. In addition to this, there is general vasodilation, or general relaxation of the arteries. This vasodilation is due to excessive catabolism to which the vascular muscles are subjected by the excess of thyroid secretion poured into the blood and which overactivates and uses up inordinately their lecithin. The same process occurs in the brain; not only is its lecithin (cephalin) overactivated and consumed in excess, but the general vasodilation causes an excess of blood to be admitted to the cerebral neurons. A third cause of cerebral disorder is the toxemia itself, not only that due to any primary infection that may be present, but also that due to the catabolic wastes to which the excessive thyroid activity gives rise.

It is this aggregate of pathogenic factors which brings on the morbid phenomena, both mental and nervous, observed in Graves's disease or hyperthyroidism. Besides the usual symptoms of this disease, there occur at first marked restlessness, leading up in some cases to great irritability and excitability. Maniacal symptoms may later appear, in which the vasomotor phenomena predominate, the face being flushed, the skin, throat, and tongue dry, and the usual throbbing of the arteries witnessed in the disease extremely marked. Dermographia is very prominent, the line left by the instrument or nail on the skin remaining visible nearly one minute. The restlessness and excitability become intensified, the patient being

noisy and even showing some tendency to violence, with the pulse high (140 to 150) and the temperature somewhat above normal. In such cases the brain and its membranes have been found to be the seat of congestion (Savage, Schenck, and others).

Conversely, *myxedema*, besides the familiar form of idiocy it induces in children, *i.e.*, cretinism, gives rise to mental disorders in nearly one-half of the cases, according to the extensive investigation of the English Myxedema Committee. Here we have the converse of hyperthyroidism, the condition described above. The types most frequently observed are *melancholia*, with delusions and hallucinations, all due to slowed metabolism occurring as a result of the deficient thyroid activity. The delusions and hallucinations are the result, from my viewpoint, of the accumulation in the tissues, including the brain, of intermediate products of metabolism which a normal supply of thyroid secretion would, in conjunction with the adrenal products lecithin and adrenoxidase as thermogenic activators of the tissue enzymes, have converted into eliminable products. The stigmata of myxedema may also be discerned, if carefully sought, in various forms of insanity.

It is important to bear in mind in this connection that the thyroid gland is the accelerator of the whole thermogenic mechanism, and that the psychoses it evokes represent either excessive or deficient activity of this mechanism as affecting the brain cells. In the psychoses due to other glands, therefore, we witness the morbid effects of one portion of this mechanism.

THE ADRENALS IN PSYCHOSES.—Addison's disease exemplifies

clearly the influence of adrenal insufficiency, which means, from my viewpoint, deficient oxidation in the brain-cells as well as elsewhere in the body. Hence the *psychic asthenia*, the somnolence, the apathy, and the almost absolute loss of will-power—*abulia*. A mild form of *melancholia* is sometimes observed in these cases.

There is also, however, a true *acute mania* which is observed occasionally in Addison's disease. This has been attributed by Chauffard, Sargent and Bernard, Laignel-Lavastine, and others to "Addisonian intoxication." While this is true, the toxemia being due to intermediate toxic wastes of deficient metabolism, there exists also, from my viewpoint, a passive hyperemia of the brain, due to relaxation of the arterioles which regulate the blood supplied to this organ. The tone of these arterioles, as is well known, is sustained by the adrenal excretory product, and when, as in Addison's disease, its supply is deficient, the arterioles relax, allowing an abnormal volume of toxic blood to penetrate the brain. The patient then abandons his passive apathy and becomes cross, sleepless, impatient, and fault-finding. Delirium may now set in, with shouts, incoherence, hallucinations, and violent excitement, the patient sometimes running about nude and resisting his attendants. After two or three hours, muscular spasms appear, leading up sometimes to true convulsions, with oscillations of the head and a tendency to asphyxia, which may prove fatal. Exhaustion may also carry off such cases when, after the convulsions, they pass into a comatose state. In a case of this sort reported by Boinet, the attack resembled closely one of delirium, al-

though the patient had not used alcohol.

THE PANCREAS IN PSYCHOSES.—The importance of the pancreas in the present connection lies in the fact that any secretory deficiency means an inadequate supply of the tryptic enzyme which, as a constituent of all cells, as I have previously shown, carries on tissue life at a rate commensurate with the heat energy developed by the thyro-adrenal mechanism. This enzyme is also the direct agent which, under the influence of heat, acts protectively in the body at large, the blood, and the lymphatics, by subjecting to hydrolysis all toxins and toxic wastes of metabolism. A deficiency of pancreatic enzyme thus means a corresponding inadequacy not only of metabolic activity but also of defensive efficiency. While no specific mental disorder has been as yet associated with the pancreas, its deficiency manifests itself in the manner to be expected from its rôle in metabolism: Deficient growth and development or infantilism, a distinct form being known as "pancreatic infantilism," to which reference was made in my article on JUVENILE ENDOCRINOPATHIES in Vol. VI. I have found pancreatic preparations helpful in various forms of feeble-mindedness in which defective mentality coincided with deficient growth.

THE THYMUS AND PSYCHOSES.—The rôle that I attributed to the thymus over two decades ago, which is that it supplies the phosphorus that a child needs in excess of its general functions to insure the growth of its skeleton and the development of its brain and nervous system, is the only one which is sustained by a comprehensive study of

both the experimental and clinical evidence on the subject. The nucleins which the thymus supplies to the body at large owe their activity to the lecithin they contain.

In the development of the mind and its rôle in the feeble-minded, therefore, the thymus plays a leading rôle. This applies also to the osseous disorders observed in them, as shown in my article on BONES, DISEASES OF, Volume II. Even the rickets following experimental thymectomy is reproduced in some cases,—the result of defective formation of calcium phosphate which the phosphorus-laden lecithin supplied by the thymus insures.

The idiocy produced in animals by the same experimental procedure corresponds precisely with the teachings of pathology. Thus, at the request of Bourneville, Katz performed autopsies in 61 mentally normal children who had died of various diseases, varying in age from 1 month to 13 years; in all of these the thymus was present. In 28 mentally weak children examined *post mortem* by Bourneville, however, the thymus was absent. In another series of 292 cases of mentally deficient children, the organ was absent in 74 per cent. At Bicêtre, from 1890 to 1903, autopsies of 408 non-myxedematous idiots ranging in age mostly from 1 to 5 years—none being above 15 years—showed the thymus to be present in only 104 instances (Morel, 1914). Lange and Dicker, Garré and Lampé have reported cases of idiocy in which at autopsy the thyroid was found quite normal, while the thymus was very small, which means a correspondingly deficient supply of lecithin and also of the activating agent, thyroiodase.

THE GONADS IN PSYCHOSES.

—Aside from the physical and mental

variations which attend deficiency of these organs, distinct psychoses occur during their involution, particularly during the menopausal period in women, and in conditions related to reproduction, pregnancy, parturition, etc., as well as in men about the sixtieth year. As these subjects will be treated at length further on in the present article, additional remarks are not needed here.

A phase of the question which should not be overlooked in this connection is the conflict between the sexual urge of adolescence and religious teachings which tend to pervert its meaning into a capital sin leading to perdition. The mental conflict which results is an important source of insanity, upon which psychoanalytic teachings rightly lay stress.

TREATMENT OF PSYCHOSES.

—The average text-book of psychiatry affords very little satisfaction on this score. Custodial care, precaution against suicide, sedatives and hypnotics, laxatives and tonics, massage, hydrotherapy, electrotherapy, surgery—often mentioned only to be condemned on groundless premises,—suggestion, persuasion, hypnotism, psychotherapy based on psychoanalysis, reëducation, and occupational therapy constitute the usual armamentarium, with the random use here and there of some endocrin preparation on purely empirical grounds. As to curative medication, the specific treatment of psychoses of luctic origin is the sole representative of what imposes itself as the dominant indication in mental diseases as well as in any other of the human ills.

It is this dominant phase of the whole subject of psychiatry which

endocrinology contributes when it is interpreted in the light of my views, by enabling us to understand the processes through which the primary pathogenic agent produces the biochemical or pathological changes that so pervert the physiological integrity of the brain. Again, in view of the facts (1) that *the endocrin organs are the actual source of the functional constituents of the brain and other nerve cells*; (2) that these constituents are those *which govern the blood-supply of these same cells*, and (3) that the blood is also the *carrier of the defensive enzymes and their thermogenic activators supplied to these cells*, we are furnished with a foundation for therapeutic measures on rational lines.

While organotherapy itself, used judiciously and with an avowed pharmacological object in view in each instance, is capable of rendering service, this will eventually prove to be slight when the profession begins to realize what I have tried to impress upon it for over two decades, *viz.*, that organotherapy is but a limited factor in endocrinology as a whole when compared with the dominant rôles I have attributed to the endocrin organs, *thermogenesis*, which includes tissue respiration, and *self-defense*, which means an auto-immunizing process that we can awaken at will.

The bearing of these remarks in the present connection is that, in psychoses as well as other diseases, we are enabled by agents which, as I have shown, increase the activity of endocrin functions incidentally (mercurials, the iodides, strychnine, and digitalis, for instance), or which enhance the efficiency of their active agents in the tissues (heliotherapy, heat, warm baths, etc.), to provoke an active defense

against all pathogenic agencies of an organic nature, micro-organisms, their toxins, and toxic wastes of metabolism. Vaccine therapy is in reality but an active stimulation of the auto-defensive endocrin mechanism. By causing a more or less great increase of the endocrin secretions in the blood, thermogenesis is raised (our "fever") sufficiently to promote increased hydrolysis by the activated trypsin.

What vaccine therapy awakens in the body in this manner, any infection capable of evoking a febrile reaction will likewise do. We shall now see that what is now regarded as the deadliest of psychoses, general paresis, which constitutes from 18 to 25 per cent. of the asylum cases, has, in many instances, become amenable to treatment by infection. The process of cure can be accounted for only through my interpretation of the defensive functions of the ductless glands.

GENERAL PARESIS.

SYNONYMS: *General paralysis; paralytic dementia; parietic dementia; general paralysis of the insane; dementia paralytica.*

DEFINITION.—General paresis is a chronic progressive psychosis characterized by mental deterioration and motor disturbances and which is now generally considered as ending in death in about three years. Modern methods of treatment by measures which increase the defensive activity of the endocrin organs, notably infection, are modifying this unfavorable prognosis. (Author's definition.)

ETIOLOGY AND PATHOLOGY.

—General paresis is attributed to syphilitic infection. It occurs, as a rule, in middle life, though rarely be-

fore the thirty-fifth year. Cases among children, due to hereditary lues, and in old persons have, however, been observed. Its effects are encountered most often in persons of means and who have more or less irregular habits. While the blood in most cases shows a positive Wassermann, and Noguchi found spirochetæ in the brains of subjects who had died of the disease, there is ground for belief that intemperance, mental stress, and sexual excesses tend to aggravate the disorder and even to initiate it. All these factors are active depressants of endocrin functions, through deterioration of the secretory activity.

The pathological lesions are such as to impair the entire brain. There is often found atrophy of the cortex, particularly of the frontal lobes, causing widening of the fissures with decrease of the total weight of the organ, softening of its substance, and dilatation of the ventricles.

Evidences of congestion of cerebral and meningeal tissues, with thickening of the latter, are sometimes noted, and likewise the presence of a milk-like fluid. The vascular elements may show lesions, mainly capillary proliferation and an increase of neuroglia.

An essential feature of the histological picture is a more or less marked diminution of the myelin sheath, with thinning of the nerve fibers. We have seen that, from my viewpoint, the lecithin of the myelin is the thermogenic factor of the nerve element which is oxidized by the adrenoxidase in the axis cylinders and their extensions in the cell body. This diminution of the myelin, shown also by the presence of freed yellow pigment—the cholesterol detached from the lecithin,—is probably the funda-

mental morbid factor of the cerebral paresis, shared also more or less by the spinal cord which caused the general paralytic phenomena. Even the bones, as shown by exostoses, hyperostoses and fragility, are affected, as are often the heart muscle, aorta, muscles, liver, kidneys and other organs. The fact that the myelin owes its activity to lecithin and that the latter body is a constituent of all the tissues found degenerated in general paresis explains in a great measure the clinical phenomena observed.

SYMPTOMS.—Among the early psychical symptoms are irritability and especially an instability of the moral and mental character. The subject is easily disturbed, emotional, of variable moods. His memory, especially for recent occurrences, becomes defective. He forgets dates, appointments, mislays valuable documents or other articles. The moral sense is often perverted. He loses that delicate sense of propriety by which his previous life has been guided. He becomes unconventional, consorts with drunkards and lewd females, makes indecent proposals to respectable women of his acquaintance, indulges in a latitude of speech and action not tolerated by the conventions of the social stratum to which he belongs; all this without recognizing any impropriety in it. He may make a public merit of his sociological study of the nude in brothels, and violate public decency by exposure of his genitals in the street, or show a coarse disregard for his own household by defecating in bed or urinating on the carpet in his room.

There is progressive inability to concentrate the attention. With the failure in memory, incidents, real or

imaginary, are embellished with fanciful details, the truth of which is asserted and maintained with vigor, and all doubts are actively and often angrily combated.

The prevailing character of the psychical manifestations is one of exaltation. Cases occur not infrequently, however, in which the keynote throughout the whole course of the disease is depression. In some instances the diagnosis of melancholia would be justified if the psychical symptoms alone were taken into consideration. Delusions of persecution may also be present, but are generally attended by expansive delusions.

Delusions of grandeur are present in most cases of general paresis, although they cannot be regarded as essential or pathognomonic. Many cases run their entire course without manifesting exaltation or expansive delusions at any time.

The delusions of grandeur are not only unreasonable, but the patient offers no reasons for his extravagant beliefs. While his imagination seems vivid, as shown in his delusions, it is, in fact, decreased. His delusions are so unrestricted that the most modest healthy imagination at once recognizes their absurdity. These delusions are rarely fixed. While there is a general sameness of the main feature—the expansiveness of the delusion,—the individual delusions are observed to vary constantly.

As the disease progresses, dementia becomes increasingly marked. The destruction of the intellectual faculties is so complete that toward the last even the delusions disappear. This progressive dementia goes hand in hand with the physical deterioration of the powers, so that when at last death comes to

end the scene the vital machine may be said to go to pieces all at once.

One of the earliest physical symptoms is persistent insomnia which resists all hygienic or medicinal agencies. It is often accompanied by intense and frequently recurring hemicrania. The sleeplessness and pain are believed by many to indicate intracranial pressure. In other cases there is an uncontrollable desire to sleep. The patient falls asleep in the midst of his occupation or in company.

Early symptoms also are losses of consciousness varying in degree from momentary dizziness to apparently true apoplectic attacks. They are present in nearly every case and are important diagnostic signs. While they are frequent and severe in the advanced stages, they are often the first indication of serious cerebral disease.

After severe attacks there may be hemiplegia, which, however, usually disappears in a few hours or days. Convulsions, epileptiform in character, may also be present as early symptoms, but are usually met with in the later stages.

Sometimes the apoplectic attacks are due to internal hemorrhagic pachymeningitis, and in these cases death often follows soon after the stroke.

Frequent among the early symptoms are those connected with the innervation of the iris. The pupil is usually irregular, mostly dilated, more rarely contracted, in the fewest cases normal in diameter. The pupils of the two sides often vary in size and reaction. The reaction to light and sensation may be retarded or entirely abolished. The Argyll-Robertson pupil, so characteristic of tabes, is

also a frequent symptom of general paresis. It probably depends upon degenerative processes similar to those of the former disease. It is said that the ocular symptoms—inequality of pupils, myosis, and Argyll-Robertson pupil—have been noted several years before the outbreak of the mental disturbances.

Other motor symptoms are changes in the deep reflexes. The patellar reflex is most often increased, but may be normal, diminished, or absent. It has no diagnostic significance except with other physical or mental symptoms.

The facial muscles often show signs of involvement. A fibrillary tremor or twitching of the muscles about the mouth, sometimes a spastic condition of single muscles or groups of muscles about the face, and loss of expression from paresis of certain muscle groups, may be present. On protruding the tongue, the organ is tremulous or protruded in a spastic or jerky manner. Tremor of the hands is also present as a symptom of the advanced stage. The writing becomes irregular and "shaky."

The speech is jerky, slow, or "scanning." In advanced cases it becomes slurring. Syllables are dropped or repeated. Certain words are pronounced with difficulty, the test phrase "truly rural" usually running into "toory looral." Later the speech becomes indistinct and finally degenerates into an inarticulate sound, in which no words can be distinguished.

The lines of expression in the face become obliterated in the later stages of paresis, but this sign can at times be noticed among the early symptoms on careful examination.

Another early symptom is retention of the urine, which is due to loss

of contractile power or of reflex sensibility in the vesical walls. In the advanced cases there is dribbling of urine and involuntary escape of feces from relaxation of the sphincters.

An annoying symptom of cortical irritation is a constant grinding of the teeth. This is so often present in general paresis that it is considered by some authors as pathognomonic, but it also occurs in some cases of simple dementia.

The gait in the early stages is spastic or ataxic. In advanced cases it becomes slouching or dragging.

In the advanced stages, coincident with the progressive dementia, there is increased motor debility. Tremors or twitchings give place to paresis, and these again to complete paralytic conditions. The patient is no longer able to keep on his feet, and after a time he becomes bedfast. The power of articulation is lost and the voice becomes an inarticulate moan, extremely distressing to the hearer.

Mastication of food is forgotten and masses too large to pass down the esophagus are partly swallowed and may cause asphyxia by compressing the trachea.

Vasomotor disturbances are frequent. The innervation of the vessels is diminished and there follows dilatation of the superficial vessels, redness or blueness of the skin, edema and cyanosis of the peripheral members, and diminution of blood-pressure.

Sometimes there are punctiform extravasations of blood in the skin, and even actual hemorrhages from the mucous surfaces, as from the bowel.

Consequent upon the defective innervation, combined with external

mechanical influences (traumatism, prolonged pressure, etc.), trophic changes occur. Bed-sores are often noticed, especially when the patients have become bedfast.

The course of untreated general paresis is, as a rule, steadily progressive. No cases of permanent arrest of the disease had been recorded until recently, under the newer methods of treatment to be reviewed.

The blood in a luetic case should give a positive Wassermann reaction; likewise the cerebrospinal fluid, the latter exhibiting also an increase in the lymphocyte count and globulin content. It should be borne in mind, however, that ingestion of alcohol within a few hours before the Wassermann test, and also in active anti-syphilitic treatment, cause the Wassermann test to be negative. Again, it should be remembered that laboratory findings can be regarded only as confirmatory of the clinical diagnosis.

In the early diagnosis of general paralysis, in about 45 per cent. of cases disordered pupillary response to light may be observed in the prodromal stage. Pupillary irregularity is extremely frequent, and anisocoria occurs in about 50 per cent. Some show early fundus changes. The patellar responses are usually exaggerated. Speech may be slow and hesitating, with a slight tendency to slurring, and the writing may also show some alteration. The lips and tongue are frequently tremulous. There may be a history of apoplectic attacks, fainting spells, headaches, aphasias, and palsies. Observation usually reveals distractibility, slight indifference and blunting of comprehension and appreciation, transitory confusions, irritability, restlessness, suspiciousness, overactivity, and even delusional trends and expansiveness. In 95 per cent. one may expect to find positive blood and spinal fluid Wassermann reactions, increased

spinal globulin and cell count, and changes in the colloidal gold and gum mastic reactions. T. Raphael (*Amer. Med.*, June, 1922).

The reactions in the serum and cerebrospinal fluid are of but slight aid in the diagnosis of general paralysis. While the clinical symptoms are constant and characteristic, these qualities do not belong to the humoral reactions. The writer observed a typical case in which the Wassermann reaction, albumin content, number of cells, and response to the benzoin test in the spinal fluid were normal. Klippel (*Médecine*, Feb., 1923).

PROGNOSIS.—The prognosis is generally regarded by text-book authors as hopeless. Periods of remission and of comparative lucidity seem to point to oncoming convalescence, but after a period of a few months to one year, recurrence becomes evident. The average duration is two to three years. Exceptions have been noted in which the survival was prolonged from six to twenty years, but various writers attribute such cases to incorrect diagnosis.

Conversely, some cases run an acute course, ending in death within a few months. Newer methods of treatment promise, however, to improve the prospects.

TREATMENT.—The prevailing text-book advice is to place all such patients in an **asylum** to protect them and others against harm, recommending that their affairs be placed in the hands of a trustee. Antisyphilitic treatment, **mercury** or the **arsenicals**—**arsphenamin intravenously** in particular, the intraspinal method being no longer employed;—**hydrotherapy**, if there is excitement, and hypnotics such as **barbital** if there is insomnia, constitute the present modes of defense against the disease.

The writers advocate the following plan of treatment: (1) **Arsphenamin** (or equivalent), 0.25 to 0.4 Gm. once weekly or every 10 days, 6 to 8 injections, followed by (2) **mercury**, insoluble preparation every 5 days, or soluble preparation thrice weekly for 2 months, or 30 rubbings. (3) **Iodides** by mouth, rectum or intravenously to tolerance for 1 month following mercury or alternating. (4) **Sodium nucleinate**, intragluteal injections of 0.3 to 1 Gm. (5 to 15 grains) or more, to induce febrile reaction, every 3 to 7 days. (5) **Reeducation** method of Maloney. (6) **Symptomatic, baths, massage, analgesics** for pain, and measures for bladder symptoms. Treatment to be repeated once or twice during the first year as indicated by benefit derived, condition of excretory organs, morale, biologic reactions, etc.; then yearly, or more or less often, gradually tapering off. The writers note a growing tendency to restrict intraspinal treatment to very narrow limits; in Europe, there has been an almost general abandonment of intraspinal methods. Kaliski and Strauss (*Arch. of Neurol. and Psych.*, Jan., 1922).

Recent labors have added much to these therapeutic resources. Various observations having shown that general paresis is often favorably influenced by some intercurrent febrile disorder, fever-producing agents were tried. Wagner-Jauregg at first used injections of 0.005 to 0.01 Gm. of **old tuberculin** under the skin of the back on alternate days, gradually increased to 0.1 or even 1 Gm. Before or after these injections, 25 injections of **mercury succinimide**, 0.2 Gm. (3 grains), were given, or 30 rubbings with **mercurial ointment**. Later, Besredka's **typhoid vaccine** in ascending doses, beginning with 25 millions, was substituted for the tuberculin. In 1917 he subjected several cases to **malarial inoculation**, with results superior to those of earlier treatments.

The procedure, as described by A. Pilcz (*Lancet*, Jan. 6, 1923), consists in obtaining 2 c.c. (32 minims) of blood during a febrile attack from a patient with tertian malaria previously untreated with quinine and injecting it under the skin of the paralytic's back. In about one to two weeks the first malarial paroxysm occurs. After ten to twelve attacks, 0.5 Gm. ($7\frac{1}{2}$ grains) of **quinine sulphate** is given twice a day for three or four days and then once daily for two weeks, thereby checking the malaria. At the same time **neo-arsphenamin** is begun; 0.3 Gm. intravenously once a week, ascending to 0.6 Gm. Of 141 paretics treated, 51 completely recovered; 18 showed marked and persisting remission, but without return to their former occupations; 57 became stationary or showed an incomplete remission, and 15 died. The remissions and serologic reactions show no parallelism.

Of 68 patients treated, 6 gave a history of previous malaria, in 4, however, prior to the chancre. All except 16 patients had received antisyphilitic treatment, usually **arsphenamin**. **Malarial inoculation** was made by injection into the subscapular connective-tissue of 2 c.c. of blood withdrawn from the donor shortly after the paroxysm. The patients were then kept in a well screened ward until their treatment was completed and it was certain that they were free from parasites, thus to prevent infection of other patients through them. The malarial treatment of paresis apparently produces a larger percentage of improved and arrested cases than other methods of treatment. W. W. Eldridge (*Jour. Amer. Med. Assoc.*, Apr. 11, 1925).

The writers treated 34 cases of general paralysis, 27 of which were in males and representing all types of the disease. The patients received either 5 c.c. of blood drawn from a case of

tertian malaria, subcutaneously, or 1 to 1.55 c.c. of typed citrated blood from a patient "already under treatment" intravenously. In all patients thus treated, from 10 to 18 malarial paroxysms were permitted to occur before the malarial process was halted by giving quinine. Of the 34 patients, 26 recovered from the malaria disorder, 1 failed to develop it, and 7 died of complications. Of the 26 recoveries, 16 were home and reëngaged in their former occupations, 9 were improved, and 5 were not improved. R. F. L. Ridgway and E. M. Green (Atlantic Med. Jour., May, 1926).

MANIC-DEPRESSIVE PSYCHOSES.

SYNONYMS: *Circular insanity; alternating insanity; cyclic psychosis; affective psychoses.*

DEFINITION.—Disorders of the brain in which a period of maniacal excitement may alternate with one of depression (melancholia), with or without a period of lucidity between them. Though apparently distinct, the two disorders are united pathogenically, the mania being due to a toxemia which evokes an inadequate and therefore prolonged defensive reaction of the endocrin system and a corresponding thermogenic activity in the cerebral cells, while the depression is due to the undue exhaustion of the functional constituents of these cells, their lecithin (cephalin) especially. The disease occurs in subjects predisposed to neuropathic disorders through heredity or premature birth. (Author's definition.)

ETIOLOGY AND PATHOLOGY.

—In this connection it is well to remember that while the term "manic-depressive" implies that mania invariably precedes the depressive phase, such is not always the case, their order being, in fact, reversed in many in-

stances. While considerable similarity exists in the pathogenesis of the two types, the fact remains that the difference in the sequence of events must be clearly understood to insure the efficiency of therapeutic and prophylactic measures that may be undertaken. It was deemed advisable, therefore, to identify two general types, the manic-depressive and the depressive-manic.

Although the disease ranks next in importance (16 to 25 per cent.) to dementia precox in our asylum population, its pathology is admittedly unknown. This was inevitable in the absence of knowledge of the functions of the ductless glands, the biochemical products of which, as I have pointed out, are the sources of functional activity in all tissues, including the brain. The dominant phases of the disease, melancholia and mania as indicated by the symptoms, may then be clearly accounted for when their causes and their biochemical effects are analyzed.

Dominating the pathology of most cases (80 per cent., according to Kraepelin) is heredity, certain families in a generation, perhaps, being predisposed to manic-depressive psychoses, while dementia precox (treated at length in the third volume) tends to appear in the next generation. In the manic-depressive group, the various forms, from my viewpoint, are due to biochemical changes in the cerebral cells, beginning with excessive intrinsic metabolism therein, causing the *maniacal phenomena* and leading to exhaustion of the same cells, thus inducing the *depressive phenomena* or melancholia.

The essential etiological factors may be divided into (1) a *mental stress* group, prolonged and intense worry, mental and physical shocks, including

those due to fright and other violent emotions, traumatisms, etc.; (2) the *toxic* group, in which various infections, focal and febrile, and other toxemias of endogenous origin due to catabolism, pregnancy, parturition, etc., play an active and dominant rôle, and (3) the *asthenic*, in which the cerebral neurons, as a result of the excessive metabolic activity to which they have been subjected, are more or less incapable of subserving their functions, as expressed in the symptomatic depression or melancholia. Some authors hold that the latter phase may be the first to manifest itself. Others, however, classify such cases under pure melancholia, the secondary phase being more in the nature of an hallucinatory paranoia.

The three groups of the true manic-depressive type described occur in logical sequence. Thus, in the first group, a violent shock or mental stress, more or less continuous, provokes a correspondingly great acceleration of the intracellular metabolism, in which the cellular cephalin (the cerebral lecithin) is oxidized at an inordinate rate by the adrenoxidase in the cellular fibrils. Cannon has duly emphasized the excessive activity of the adrenals in all forms of stress, fright, etc., in experimental animals. In the second group, focal and febrile infections, pregnancy, etc., evoke an antitoxic reaction in which all the ductless glands, the adrenals and thyroid in particular, take an active part, the more or less intense febrile process promoting thermogenesis at the expense of the cerebral lecithin as well as of that in all other tissues. In the third group, the destructive effects of the excessive consumption, not only of this thermogenic

agent, but also of the adrenoxidase, thyroiodase and other endocrin products, manifests itself by its logical consequence insofar as the mental status is concerned—the depressive phenomena formerly termed melancholia.

Manic-depressive insanity is more common in the female than in the male in the proportion of about four to one, according to most authors—a fact probably accounted for by the greater susceptibility of the nervous system of the female to emotional factors, the metabolic disturbances connected with menstruation, parturition, and the menopause, and the greater frequency of endocrin imbalance.

The successful results obtained with febrile disease inoculations, the beneficial effects of which have been noted also in tabes, multiple sclerosis, and in other forms of neurosyphilis, strikingly sustain the personal opinion already submitted, that failure of the endocrin apparatus is the underlying cause of certain psychoses, since, as I have pointed out, the dominant function of this apparatus is that of **thermogenesis**, *i.e.*, heat production, a supernormal manifestation of which is the defensive function of **fever**. The febrifacient treatment of general paresis and other psychoses thus means stimulation of the endocrin organs.

DEPRESSIVE-MANIC TYPE.

—While the above pathological picture typifies the condition which the term “manic-depressive” psychoses implies as to the order of the two strikingly different phases—mania preceding melancholia,—it should be remembered that the *first* attack followed by a remission is often one of melancholia or depression. Here, the pathogenesis cannot be

attributed to a preliminary maniacal attack which deteriorates the cerebral lipoids. The pathogenesis is, in fact, reversed.

The instability of the molecular structure of the cerebral neurons due to inherited stigmata remaining identical, the debilitating effects, though not initiated by any sort of primary overactivity, are the result of a primarily debilitating factor which so undermines the cortical cell that it is unable to recover normally. Thus, too prolonged lactation, by reducing too greatly the lecithin (cephalin) and calcium in the cortical cells to insure adequate bone-building materials for the nursing; a similar process during pregnancy for the benefit of the developing fetus; prolonged worry and physical suffering such, for instance, as that of *tic douloureux*, gastrointestinal disorders, which lower the functional efficiency of the sympathetic system through shock, thus causing a passive vasodilation of the arterioles, entailing a reduction of the cerebral nutrition, etc.—any of these may render the cortical cells unable to carry on adequately their mental functions, more or less melancholia or depression resulting.

Purely on a chemical basis, therefore, and as often noted by histologists with no demonstrable pathological lesions, three dominant psychic symptoms appear more or less clearly defined: Slowness and difficulty of thinking, emotional depression, and psychomotor retardation, the high lights of melancholia.

A single attack, lasting from a few days to many months, is usually followed by recovery, provided that the cause be removed. The attacks may recur under, perhaps, the influence of

other debilitating conditions; or, after a period of remission, symptoms of mania—those to be described presently—appear.

SYMPTOMATOLOGY.—The onset of the maniacal symptoms is insidious, the first indications being an abnormal increase of activity, mental and physical, followed by lack of order in the flow of ideas and in activities. Plan succeeds plan almost as soon as formed, deviation from one to the other being caused by any trivial occurrence. There is increasing emotional irritability and volubility, the patient resenting the slightest interference. He is always busy and overconfident in his own abilities in any particular line, commercial, financial, inventive, etc., a state of mind which may, and often does, lead him into serious trouble. A proclivity to alcoholism, sexual excitement, lewd talk and boisterousness is not infrequent in both sexes, leading sometimes in young females to regrettable complications.

This phase is sometimes termed that of *hypomania*, owing to the lack of truly maniacal symptoms. It may even be milder than has been depicted above, the condition being one of euphoria, with marked energy to accomplish much, but with more or less excitement as an eventual tendency and a marked propensity to deviate from one task to another, leaving the preceding one unfinished.

When the stage of *acute mania* is reached, all the foregoing symptoms are aggravated, pure excitability being supplemented by acts which clearly denote insanity. Rhymes without sense but characterized by sound similarities or “clang” are often indulged in. The sentences in conversation become incoherent. Wrong names are applied to individuals, animals and inanimate

things. Intense restlessness with outbursts of psychomotor activity may cause the patient to scream, jump about, attempt somersaults, and destroy things about him, even his own wearing apparel. Outbursts of senseless and boisterous laughter are more or less frequent, while extreme irritability and fits of anger are common, occasionally with persecution delusions as underlying stimulus. Conversely, the depression may be so deep as to cause weeping, wringing of the hands, etc. Hallucinations may also develop, but, as a rule, they are simple and transitory.

A more dangerous stage is characterized by aggravation of all the foregoing morbid phenomena, the flight of disconnected ideas being replaced by complete incoherence lapsing into delirium. Insomnia, almost the rule from the start, becomes uncontrollable, while refusal of food leads at first to emaciation, then exhaustion and vulnerability to infection, owing to the decline of all systemic defensive reactions. A slight injury or scratch may now become transformed into a large suppurative area; acute disorders of the internal viscera readily develop, and acute infectious disorders of all kinds are apt to assume dangerous proportions. The calls of nature are neglected, and, this applying also to the patient's person, he becomes on the whole, unless provided with every care, a repulsive object. Any intercurrent disease, pneumonia particularly, may then readily prove fatal.

All special signs and laboratory tests in acute mania indicate excessive functional activity. The temperature is above normal and the skin as a rule hot and dry, a subnormal temperature be-

ing apt to indicate impending collapse. The basal metabolism is also more or less high in the acute stage, and the pulse rapid and sometimes bounding. That this stage is attended by an active oxidation of the phospholipoid lecithin is well shown by the fact that the urine, even though scanty, is loaded with phosphates, often with albumin, peptones and propeptones.

While the more severe types last described may prove fatal, the less grave forms may, and often do, undergo recession until a period of recovery occurs. This, however, may be only temporary, and the mania recur—*recurrent mania*,—to be followed anew by a phase of recession, periodical attacks and recovery intervals succeeding one another, in some instances, with approximate regularity. In the present connection, however, we are dealing with the type in which, after a recession of the maniacal symptoms, those of the depressive phase soon follow.

Depressive Phase, or Melancholia.

—After a period of comparative mental and physical comfort, varying greatly in duration in different patients, the symptoms of depression gradually appear. The first to manifest themselves are slowness and difficulty of thinking. The patient not only speaks slowly, but in a low voice and preferably in monosyllables. The psychomotor depression is also shown by the slowness with which he moves about and the desire for solitude. As it progresses, he is unable to initiate a mental effort, even reading or writing, and is more or less profoundly depressed, being fully aware of his mental condition. He not only thinks with marked difficulty, consecutive mental acts being virtually impossible,

but he fails to grasp the meaning of what is told him.

The deep sadness involved leads to delusions in which self-accusation of weakness, of sinful conduct believed to compromise the future of the soul often predominates. Or, the patient believes himself extremely ill, some part of the body, the intestines especially, being thought to be undergoing decay, for example. A feeling of impending danger may so dominate his mind that any attempt to reassure him is futile. Hallucinations are not infrequent, usually of a horrifying nature, and followed in some patients by a period of stupor.

As the case progresses, apathy or physical torpor becomes increasingly evident. The patient in some instances becomes inactive to such a degree that he has to be tube-fed, while his every need has to be met by an attendant. Mutism in such cases is the rule, a stuporous state prevailing, from which he can be roused only with difficulty, the face being literally mask-like. The motor mechanism is sufficiently in abeyance in some cases to prevent winking and swallowing, the sphincters, vesical and rectal, losing their retentive powers, with wetting and soiling as result. Catalepsy is not infrequently observed.

Sudden reactions almost any time in the course of the depressive phase include an utter indifference concerning death, attempts at suicide being common. This danger imposes the need of closely watching such cases.

All special signs clearly betoken a general functional depression. The temperature is frequently subnormal, the extremities cold and even blue in stuporous cases. The conjunctivæ are anemic and the pupils, as a rule,

widely dilated. The secretion of tears, saliva, gastric juice, and urine is generally reduced. Deficient chloride excretion is usually marked, while that of indican testifies to defective intestinal activity, as further indicated by obstinate constipation.

DIAGNOSIS.—The disease with which manic-depressive insanity is most likely to be confused is *dementia precox*, particularly the catatonic type of the latter. If a history of previous attacks of the former disease exists, the diagnosis is readily reached. In some cases, however, the differentiation is complicated by the fact that symptoms of both disorders are present in the first attack of mania, but the situation is cleared by the appearance of the depressive phase, which does not occur in *dementia precox*. Again, any catatonic symptom which may occur in mania is not attended by the mutism, negativism, and rigidity observed in *dementia precox*.

The depressive phase resembles and is apt to be mistaken for *neurasthenia* when it precedes the manic phase, but neurasthenics fail to show signs of mental aberration. *General paresis* is another source of confusion, but its nervous manifestations, puerile delusions, and a positive Wassermann soon settle the question in practically every instance.

PROGNOSIS.—Although recovery is usual in individual attacks, even though they may last from a week to many months, the likelihood of recurrences is so great that the prognosis should be guarded. The chances of recovery are vastly increased, however, if the causal factors of mental stress, worry, and other emotional traumatisms or the causes of intoxication, focal or general, can be elimin-

ated. Many of these, *e.g.*, pregnancy, parturition, etc., are but temporary factors which offer a correspondingly better prognosis. Recurrence of attacks, especially if they are increasingly prolonged while the intervals become shortened, decreases the chances of permanent recovery, but inasmuch as the disease does not involve a special tendency to deterioration, life itself is not materially compromised.

TREATMENT.—Although manic-depressive psychosis is said to cause no organic lesions nor to be attended by any such lesions,—a belief apparently sustained by the complete recovery observed in many cases,—the fact remains that a relatively large proportion of them undergo repeatedly the periodical phases of the disease, some of such cases eventually dying owing to its ravages. In the light of my own views, the absence of discernible organic changes referred to by many authors is accounted for by the fact that both the manic and depressive states are due to biochemical factors which leave no clearly defined landmarks of the damage done. The dominant indications consist of an early diagnosis and prompt application of measures calculated to reduce the exaggerated functional activity of the cerebral neurons in the manic phase and, conversely, to restore the constituents which they lack during the depressive phase.

Prompt **attention** should be given to the fundamental **exciting cause**, focal or general. Some of the general causes, *e.g.*, pregnancy and parturition, are self-limited; this is true also of temporary febrile infections, and it may be said to apply likewise to cases traceable to mental stress, worry, sorrow, traumatic shock, etc., in which

a toxemia is due to toxic wastes of catabolism of nervous origin promoting a defensive reaction in which the thyroid takes an active part. The mania of hyperthyroidism or exophthalmic goiter is similarly produced, the cerebral lecithin (cephalin) being rendered unduly sensitive to oxidation, as shown by the phosphaturia.

Focal infections are, however, seldom self-limited. Diseased tonsils, which often cause a marked toxemia, abscessed teeth proven to be such by X-ray examination, disorders of the genital and urinary apparatus and intestinal tract, etc., are prolific causes of mental disorder in predisposed subjects. In a case of my own, opening of the cecum for daily irrigation to eliminate fecal accumulations eliminated mania in a severe case, the recovery now exceeding ten years in duration.

In a large institution for the care of the insane, remarkably few of the female inmates were found free from some more or less severe gynecological disorder. Among the commonest were the various forms of inflammation of the vagina and associated glands, the cervix, and the uterus, both of its mucosa and its wall. Prompt and efficient treatment of those conditions amenable to simple measures and productive of physical annoyance afforded most gratifying results in the reduction of the patients' excitation and, secondarily, in improving their mental states. Alice M. Smith (*Northwest Med.*, Sept., 1917).

The writer treated successfully 1400 cases of insanity during the 4 years preceding the report, and had but 42 return to the hospital. During the preceding 10 years the spontaneous recoveries (without surgical treatment) had been 37 per cent. Deducting a corresponding number from the 1400 cases to obtain a ratio of those cured by operative treatment would leave to the credit of the latter, deducting the

42 returns, 942 cases. This should prove convincing as regards the value of **surgical detoxications**. It is imperative, however, that every patient admitted to the hospital be rigidly examined and all **foci of infection eliminated**. H. A. Cotton (Amer. Jour. of Psych., Oct., 1922).

Diphtheroid organisms and streptococci were found within the cervical canal in a large proportion of 250 female insane examined on account of gynecological disturbance. Bacterial infection of the urinary tract was found in many patients. Distinct mental improvement followed effective treatment. Research Board of Birmingham University and the Scottish Western Asylums Laboratory (Lancet, Dec. 15, 1926).

The fact that many subjects who harbor focal and other infections are not insane has been thought to invalidate these agencies as cause. But the fact that functional psychoses do not occur in every one meets this objection, by showing that heredity and other constitutional factors predispose certain individuals to mental disorders which will not occur in others.

MANIC PHASE.—An important question is the actual nature of the process through which toxics produce the maniacal symptoms. From my viewpoint, it is not the toxic which provokes them, but *the defensive process* which the toxemia evokes. Such a reaction includes the brain, as shown by the temporary delirium often observed in any individual in the course of fevers. If the defensive process were sufficiently active, the pathogenic agents would be destroyed, but the *underlying cause of trouble is that the defensive process, though very active, is inadequate, and excites the cerebral cells without overcoming the toxemia or bacteriemia*.

The general indication, therefore, is to enhance the activity of the defensive process. From my viewpoint, we have seen, it is the thyroid hormone which provides for this by increasing the thermogenic activity of lecithin (cephalin in the brain) thus activating the bactericidal and antitoxic properties of the tissue enzymes. The clinical experience of many psychiatrists has confirmed this interpretation. Though administering **thyroid** empirically, they found it to be very efficacious in the treatment of the manic phase, even in acute delirium. At first the doses administered were excessive, but gradually it was found that doses ranging from 2 to 4 grains (0.13 to 0.26 Gm.) three times a day sufficed, some cases requiring larger doses than others.

In certain instances, however, thyroid gland does not act satisfactorily. The reason for this becomes plain when we recall that the organs which play the dominant rôle in the defensive process, *viz.*, the thyroid, adrenals, and pancreas (the latter contributing the defensive tryptic enzyme), may be the seat of sclerotic changes, due to prior local lesions in the course of febrile diseases, those of childhood in particular. The thyroid itself may be goitrous and deficient; the adrenals, sclerotic from the previous hemorrhages; the pancreas, likewise.

The writer examined histologically 40 cases of insanity—manic-depressive, schizophrenia, paraphrenia, general paralysis, etc. In manic-depressive insanity, schizophrenia, paraphrenia, and epilepsy he found in some few cases slight changes of the endocrinal glands, specially *sclerosis* in case of implication with tuberculosis. In case of delirium there was atrophy of the colloid in the thyroid gland and deficiency of the visible lipid in the adrenal cortex. N. C. Borberg (Bibliotek f.

Laeger, *cx.* 45-63, 126-130, 187-194, 231-242, 338-370, 1918).

In such cases the addition to the desiccated thyroid of **suprarenal gland**, 2 grains (0.13 Gm.), or, in females, **ovarian gland**, 5 grains (0.3 Gm.), either one with **pancreatic extract**, 2 grains (0.13 Gm.), three times daily, will improve the results. **Parathyroid** might be tried in $\frac{1}{10}$ grain (0.0065 Gm.) doses to enhance the activating effect of the thyroid upon thermogenesis and, as a result, the efficiency of the antitoxic process.

In some instances the causal intoxication resists even the most active defensive efforts of the endocrin organs, and violent mania, due to the antitoxic process, persists. The therapeutic use of **vaccines** or of some controllable infection such as **malaria**, as in general paresis, might prove useful. It sometimes becomes necessary to resort to **partial thyroidectomy**, if **X-ray** treatment of the thyroid does not control its erethism.

Case in a girl of 18 years, apparently normal except for a goiter, in whom acute mania of a gay, laughing, restless type occurred. After 5 months, part of the thyroid was resected. The mania subsided at once and permanently. The ovaries were evidently normal, as menstruation was regular. A. Stocker (*Revue neurol.*, Sept., 1919).

Out of 24 goitrous insane, 70 per cent. suffered from manic-depressive psychoses. The relations between certain psychoses and pathologic thyroid states are also shown by: (1) The marked improvement or cure of the mental symptoms which follows the **removal** or **X-ray treatment** of tumors of the thyroid; (2) histologic proofs of alterations of the thyroid in certain cases; (3) experimental tests which show the presence of a condition of hyperthyroidism in various cases. Laignel-Lavastine (*Progrès méd.*, Apr. 8, 1922).

The symptomatic treatment is essential in mania, particularly during the acute attacks. Sleep is all-important, while it favors the antitoxic process by reducing to a minimum the production of catabolic wastes. **Barbital** in 5 to 10 grain (0.3 to 0.6 Gm.) doses suffices under normal conditions, but during acute accesses, **trional** has been termed "almost a specific" as a sedative and hypnotic. **Dial**, **isopral**, **paraldehyde**, and **chloralformamide** have also been recommended by various alienists. **Scopolamine**, $\frac{1}{100}$ grain (0.00065 Gm.), is used by some, but idiosyncratic susceptibility to its effects occasionally appears. It should be used, therefore, only where other agents have failed to overcome acute delirious mania. **Chloroform** anesthesia sometimes is necessary.

An agent which favors recovery besides allaying excitement is **calcium lactate** in 10 grain (0.6 Gm.) doses with the meals, reduced to 5 grain (0.3 Gm.) doses when the sedative effects have become manifest. Graves, who advocated the use of this salt, noted no untoward effects.

In the writer's cases, suffering from various degrees of excitement, the beneficial effects of **calcium lactate** became evident within 24 hours. It reduced the pulse and strengthened the heart action. In very severe cases it should be given also at night. It is likewise efficient in the excitement periods of melancholia. Graves (*Brit. Med. Jour.*, Apr. 5, 1919).

Prolonged **baths** at body temperature or slightly above, the patient being preferably suspended in a hammock, with his head on a rubber pillow and with **cold compresses** on his forehead, are sedative in their action. Patients are often left many hours in them, even days.

It should be remembered that constipation tends to promote maniacal attacks. **Enemas** to empty the colon are often efficient. **Magnesia should be avoided**; I have often observed that in convulsive or spastic subjects it tended to aggravate this phase of their case.

Careful and tactful orderlies or nurses are of major importance in the care of such patients. They are prone to alcoholism, and the crethism of the cerebrospinal system greatly increases the sexual urge, thus rendering both males and females, not excepting virgins, abnormally erotic. Close watching is therefore imperative. Mechanical restraint in locked quarters, however, only serves to aggravate the case by creating irritation. Isolation in a private but unlocked room is sometimes helpful by eliminating exciting factors, particularly if, with the aid of hypnotics, **sleep and rest** can be secured.

DEPRESSIVE PHASE.—In this phase, we have seen, we are dealing with slowed metabolic activity in the cerebral cells and the nervous system at large—instead of the accelerated metabolism of the manic phase. The pathogenic factors may be toxicemic as well, however, and due to exogenous or endogenous bacterial toxins, catabolic toxics, etc. The dominant note of the process is the inability of the endocrin defensive mechanism to functionate at all, or its functioning only to a degree quite insufficient to sustain (1) the vital process itself, metabolism, which includes both anabolism and catabolism of the normal tissue wastes, and *besides*, (2) the defensive process incident upon the additional focal or other infections or toxemias. This inability to carry on

extra antitoxic duty may be due to exhaustion of all, or of one or more, of the endocrins taking part in the defensive process during the manic phase—a succession of events which explains the occurrence of *mania first and depression next*.

Or, the depression may, as we have seen, be primary and be due to acquired or inherited deficiency of all the endocrins, the need of additional functional activity to sustain the extra work imposed upon them by the toxemia causing a further depreciation of the glands. Hence the concomitant asthenia, mental torpor, and melancholia, and the periodical occurrence of excitement, which reflects transient antitoxic efforts of the endocrin system. As these defensive waves become more frequent they initiate finally the manic phase. Even these rapid and finally interwoven exacerbations of defensive activity do not overcome the toxemia, though sustaining excessive metabolism in the cerebral cells, the source of the maniacal phenomena. We thus have the converse of the preceding condition, *viz.*, the occurrence of *depression first and mania next*.

When it comes to treatment, therefore, the salient point to remember, from my viewpoint, is that whether we be dealing with manic-depressive or depressive-manic psychosis, we are *always in the presence of endocrin defensive deficiency*. What is indicated in these cases is anything that will raise the defensive functions to the required degree. This accounts for the previously unexplained fact that active intercurrent infections, **erysipelas**, for instance, have brought on rapid recovery. They so violently stimulate the endocrin organs that the causal factors of the psychosis are incidentally destroyed.

The late influenza epidemic, which affected 4010 inmates, gave a wonderful opportunity to note the effects of an intercurrent febrile attack upon the subsequent course of many psychoses. When the abruptness and rapidity of the improvement is considered, the conclusion is reached that recovery was hastened and probably brought about entirely by the attack of influenza. H. G. Hubbell (State Hosp. Quarterly, Feb., 1920).

Cases of depression due to mental stress are no exceptions to the rule, as the toxemia in such, as I have pointed out, is due to cerebral catabolic wastes.

In a girl of 26, the mental breakdown, of a severe type, was attributed to masturbation, family troubles, and a prospective intolerable marriage. Psychoanalysis and suggestion having only aggravated matters and stigmata of hypothyroidism being present, **thyroid gland** was administered. She improved rapidly and apparently settled her own conflicts. H. Crichton Miller (Med. Press, Aug. 11, 1920).

In view of the fact that it is the defensive process which must be activated, it is immaterial whether the signs of hypothyroidism be sufficient to be detectable or not, since the process involves various glands. Again, the degree of illness does not influence the effects. **Thyroid gland** has been found of value even in melancholic stupor, just as it is in maniacal stupor. In some cases there is need of participant factors of the defensive process to promote its efficiency. To the thyroid gland, 2 to 3 grains (0.13 to 0.2 Gm.) three times a day, may be added **suprarenal gland**, 2 grains (0.13 Gm.), and **strychnine**, $\frac{1}{60}$ grain (0.001 Gm.), which, as I pointed out in 1907, stimulates the adrenals, the fundamental organs in the process.

The writer obtained complete cure of melancholic depression in 5 adults,

and nearly complete cure in a sixth case, by giving **strychnine** in large doses. The effect does not begin until after 0.05 Gm. ($\frac{3}{4}$ grain) of the alkaloid has been taken—this requires about a month,—and the drug has to be pushed to the limit of tolerance. It takes up to 0.07 or 0.08 Gm. ($1\frac{1}{2}$ to $1\frac{1}{4}$ grains) to saturate the nervous system. This seems to create a sort of organic shock which rouses the patient from his torpor and restores him to normal life. Strychnine has a powerful action on the centers of vegetative life. P. Hartenberg (Prog. méd., Mar. 19, 1921).

Bed treatment is generally recommended, to conserve as much as possible the patient's energy. Food refusal is usual. The importance of this drawback asserts itself when it is recalled that all the biochemical agents which serve to build the endocrin secretions are derived from our aliments. **Ample food**, with resort to **tube feeding** if necessary, has been termed the key-note of success.

These patients require **close watching** at all times owing to their marked inclination to suicide. Stuporous patients need frequent changing of the body position in bed to avoid bed-sores, and the use of the catheter and enemas. **Baths** similar to those used in mania are restful. Sleep should be encouraged, but mild hypnotics should alone be used, **barbital** for instance, with **hot milk** and other familiar aids. **Trional** may also be used in moderate doses, but sulphonal should be avoided, as it tends to cause constipation and decompose the blood in weaklings, causing hematuria.

TOXIC PSYCHOSES.

This series of disorders contributes evidence to the soundness of the view that toxemias of any kind underlie the genesis of psychoses, including those

already reviewed, which aggregate almost one-half of all cases admitted into asylums.

DEFINITION.—Toxic psychoses embrace the many forms of intoxication capable of evoking symptoms of mental aberration, notably by cocaine, lead, mercury, and carbon monoxide. The mental phenomena due to these drugs have been referred to under their respective general headings. Alcohol, the most important of the series, also gives rise to various forms of psychosis. Some of these forms, *viz.*, acute *alcoholic delirium*, *delirium tremens*, and *chronic alcoholism*, have already been reviewed in the article on ALCOHOL, in Volume I, to which the reader is referred. There remain to be considered, therefore, the following forms of psychoses of similar causation: *Korsakow's psychosis*, *alcoholic hallucinosis*, *alcoholic pseudoparanoia*, and *alcoholic pseudoparesis*.

ACTION OF ALCOHOL UPON THE ENDOCRIN SYSTEM.—It is important, in the present connection, to understand clearly the influence of alcohol upon the various ductless glands. Again must I urge the adoption of my views, since it is only through the functions that I have attributed to these organs, thermogenesis, as summarized at the beginning of this article, and the effects, both beneficial and morbid, of this function, that the pathological effects of toxemias can be understood.

Study of the action of alcohol (see Med. Record, Aug. 13, 1921) led me to the following conclusions: 1. Small doses in free dilution have a stimulating action upon the adrenals. These organs, by increasing the oxygen intake, add to the heat energy liberated by the oxidation of the alcohol itself, a potent agency for the prompt acceleration of cellular metabolism, which entails a corresponding rapid resumption of depressed vital functions.

2. Alcohol increases general metabolism: (1) By becoming itself oxidized and thus increasing the heat energy liberated in the

blood and tissues; (2) by stimulating the adrenals, which govern the intake of oxygen and thermogenesis and sustain anabolism, and (3) by stimulating the thyroid, which activates thermogenesis.

3. In stimulating but non-toxic doses, alcohol increases the functional activity of the endocrins. This action, through the adrenals and thyroid especially, increases the cardiovascular tone, respiratory activity, the rate of metabolism, and the efficiency of the defensive functions.

4. In *toxic doses*, the excess of alcohol taken becomes oxidized at the expense of the oxygen in the blood. The tissues, including the endocrins, being inadequately supplied with oxygen, their metabolic rate is slowed, the cardiovascular tone is lowered, and the defensive efficiency of the body is reduced, giving rise in marked cases to the symptomatology of acute alcoholism.

5. When the use of toxic doses of alcohol is prolonged, or becomes habitual, the excessive heat energy developed in the tissues by the oxidation of the alcohol increases sufficiently the proteolytic activity of the tissue enzymes to cause autolysis in various highly differentiated tissues, including the endocrins, brain and nervous system, causing focal lesions in them which impair their functions temporarily or permanently.

KORSAKOW'S PSYCHOSIS.

SYNONYM: *Polynuritic insanity*.

DEFINITION.—This disorder is due, in most instances, to chronic alcoholism, but may also be caused by other poisons which, absorbed in sufficient quantities, cause general vasodilation and passive hyperemia of the brain and nervous system, thus inducing a psychosis and polynuritis. It may also be caused by chronic diseases which lead to hypoadrenia, or exhaustion of the adrenals, thus inducing the general vasodilation and passive hyperemia which initiates the disease. (Author's definition.)

ETIOLOGY AND PATHOLOGY.

—Although this mental disorder is mainly due to alcoholism, this is true only in 60 per cent. of all cases, the

same syndrome having been observed in chronic poisoning by lead, arsenic, carbon disulphide, and mercury, and also in various chronic diseases such as influenza, tuberculosis, typhoid fever, septic infection, and diabetes. It is observed more frequently in adult females than in males.

Despite its varying causation, the autopsy findings uniformly point to degeneration of the entire nervous system, cerebral, spinal, and peripheral, following a marked primary congestion. These changes account for the polyneuritic phenomena observed in addition to the psychosis proper. The liver, kidneys, and heart muscle likewise show evidences of degeneration. These histological changes tend, from my viewpoint, to indicate in all cases a general dilation of the arterioles, including those of the brain and of the nerves, a condition accounted for by the vasodilator effects of the causal toxics and chronic disorders, the latter causing insufficiency of the adrenals, which sustain vascular tone. Hence the infiltration of the nervous tissues observed, with swelling of the nucleus and cell body of the neurons, followed by chromatolysis and final disappearance in some instances of the whole cell body. These changes are observed in the cells of the cerebral cortex, the motor cells of the spinal anterior horns, and particularly in the columns of Goll. In some subjects the peripheral nerves are the first to bear the brunt of the disease, with multiple neuritis as consequence. Conversely, the peripheral nerves are sometimes free of involvement sufficient to evoke neuritic symptoms.

SYMPTOMS.—The symptoms of Korsakow's psychosis occur in most

cases in association with those of polyneuritis. The most striking mental phenomenon is that termed "par-*amnesia*," a perversion of the memory which causes the patient to visualize mentally and describe various imaginary incidents, experiences, adventures in which he thinks he has or is taking an active part. Often, owing to the excitement caused by the primary, though passive, cerebral congestion, he experiences hallucinations of fear lest he be accused of immoral sexual acts, rape, incest, etc., while his cutaneous sensory disturbances, hyperesthesia in particular, also due to passive congestion, inspire terror of snake-bites, stabbing, and other injuries. This attitude of mind leads him to fear even his wife, children, relatives, and friends at times, and prompts their destruction or at least vicious attacks upon them. The memory for recent events is poor, and may, in fact, be *null*, while occurrences of former years are readily recalled.

Emotional outbursts of hilarity or weeping on the slightest provocation are common. The susceptibility of these patients to suggestion is striking. They will build up an evidently fantastic romance upon a word or sentence spoken before them, expressing it in a coherent flow of language and ideas, fully imagining their participation in the events recounted even though the walls of a padded cell and their attendant be the only objects in sight.

The polyneuritic symptoms may be very slight and be elicited only by compressing the larger nerve trunks, particularly at the points of exit from the bony foramina. Severe cases may show, as in chronic lead poisoning, wrist- or foot-drop, the nerves of the extensor muscles being those mainly

involved. Neuritis of the phrenic nerve may cause disturbances of respiration by paralyzing the diaphragm, and the cardiac rhythm may be affected. Intercurrent diseases, pneumonia in particular, usually close the scene.

PROGNOSIS.—The histological changes described being those of fatal cases, they do not exemplify those present in the vast majority of instances (95 per cent.), which, examined similarly, would probably show only passive hyperemia or congestion of the affected cells. Thus, the prognosis is reasonably favorable in the average case. A weak or irregular heart action or both betoken impending heart failure; considerable albumin or sugar in the urine and anuria are also unfavorable signs. Convulsions, which sometimes end the scene, betoken the underlying dominant cause of death, toxemia, where the renal excretory system is no longer pervious.

TREATMENT.—**Withdrawal** of the **pathogenic agent**, alcohol or drug, is the self-evident major indication. As regards the cases due to infectious disease, the fundamental disturbance, from my viewpoint, is terminal hypoadrenia, *i.e.*, exhaustion of the adrenals. As soon as evidences of the Korsakow syndrome appear, therefore, efforts should be made to restore the vascular tone to normal by administering **adrenalin** in full doses—since very small doses tend to cause vaso-dilation,—6 or 7 minims (0.36 to 0.42 c.c.) of a 1:1000 solution being injected intramuscularly in a syringe-ful of **saline solution**, with smaller doses repeated at intervals according to the needs of the case, sex, age, etc.

This treatment is applicable in cases due to arsenic poisoning as well,

since, as is well known, the arsenicals, such as arsphenamin, produce acute symptoms which are promptly relieved by injections of adrenalin. It tends also to counteract the cardiac failure as well as the cerebral and meningeal passive congestion and edema, and to restore renal activity by causing contraction of the dilated renal arterioles to their normal caliber.

Digitalin in $\frac{1}{10}$ grain (0.0065 Gm.) doses three times a day tends also to sustain the cardiovascular tone and to favor renal activity. It may be administered in addition to the adrenalin.

All this applies also to the cases due to infections, the condition present being in great part due to hypoadrenia, *i.e.*, adrenal exhaustion.

At present, nothing is advocated in text-books excepting commonplace measures such as **cathartics**, **warm baths**, **massage** of the painful limbs, and the **constant current**, **rest in bed** during the acute stage, and a **light** and **nutritious diet**. The use of the agents recommended above, however, will probably annul the mortality observed in these cases, when the patient can be seen early enough to forestall atrophic changes in the cerebral cortex.

The polyneuritic symptoms being due also to paretic hyperemia of the nerves, the **adrenalin** treatment described is again beneficial. The vaso-constrictor analgesics, such as **acetphenetidin**, **acetylsalicylic acid**, and the **bromides**, the latter, however, in small doses, large doses causing vaso-dilation. The affected limbs should be protected from the weight of the bed clothing.

ALCOHOLIC HALLUCINOSIS.

DEFINITION.—This disorder, which may be *acute* or *subacute*, usu-

ally follows a debauch or an attack of delirium tremens in chronic alcoholics, when they abstain from food. The hallucinations are due mainly to hyperemia of the cerebral cortex. (Author's definition.)

PATHOLOGY.—In the light of the pathology of Korsakow's psychosis as I have interpreted it, that of alcoholic hallucinosis becomes plain. Briefly, the debauch, by causing passive dilation of the arterioles, including those of the cerebral vascular system, causes hyperemia of the cortex. If to this is now added food deprivation, entailing absence of the principles out of which the endocrin secretions, notably those of the adrenals, are built, this vasodilation and the cortical hyperemia are correspondingly increased.

SYMPTOMS.—The symptoms of the *acute* form correspond with what should be expected from a cerebral hyperemia, the various senses, particularly those of hearing, taste and smell, being the source of hallucinations. All these are of a very unpleasant nature, voices accusing the patient of sexual acts of the lowest kind; taste and smell suggesting poisoned foods, beverages, etc. Congestive headaches and insomnia are also marked. Delusions of persecution are common, supposed enemies, including perhaps friends and even members of the patient's family, being thus exposed to assault and injury. Attempts at suicide may occur, due to periods of intense depression and apprehension.

The *subacute* form differs from the acute only in that the emotional states are less intense and the general conduct of the patient correspondingly less abnormal.

A disorder termed **ALCOHOLIC PARANOIA** is also identified by some authors as a separate clinical entity, but it differs from the above only in that it occurs as a result of the prolonged use of alcohol, and that the delusions of infidelity and jealousy predominate.

Another kindred disorder is that termed **ALCOHOLIC PSEUDOPARESIS**, due to deterioration of a more advanced character, and including probably, besides the general vasodilation of the entire cerebrospinal and peripheral nervous systems, the cellular autolysis and partial destruction observed in some fatal cases of Korsakow's psychosis. The psychosis here is accompanied also by polyneuritis, cutaneous sensory phenomena, disorders of speech and locomotion, tremors, and ephemeral pareses. The mental symptoms, of a maniacal order, often terminate in dementia.

PROGNOSIS.—Under present methods of treatment, attacks of *alcoholic hallucinosis* last from one to two weeks, according to the severity of the case, if no intercurrent infection complicates the morbid process. What cases I have had occasion to treat by measures based on those already described, however, bid fair to shorten the duration of the disorder and prevent the development of mental complications. In *alcoholic paranoia*, a quiet environment, after the alcohol is withdrawn, is of benefit, and recovery is apt to follow and endure if the use of alcoholic beverages is not resumed. In *alcoholic pseudoparesis* we have an example of the deterioration which might be avoided were all cases of alcoholic psychoses treated early, *i.e.*, before degenerative lesions of the cortical and other neurons are allowed to prevail.

TREATMENT.—The treatment of alcoholic hallucinosis does not differ from that of Korsakow's psychosis, considered under the preceding heading. This applies as well to that of alcoholic paranoia, though here special precautions are necessary to prevent aggressions and possible serious injury to persons exposed through the patient's delusions. In alcoholic pseudoparesis similar measures are indicated, but early in the course of the case, and in addition, the immediate withdrawal of alcohol if the trend towards dementia is to be arrested.

INVOLUTIONAL MELANCHOLIA.

SYNONYMS: *Pre-senile psychosis; climacteric melancholia; menopausal psychosis.*

DEFINITION.—Involutional melancholia is a depressive state which occurs during the climacteric period in both sexes, but usually during the fifth decade in women and the sixth decade in men. It is a consequence of the involution of all the endocrin glands, and is accompanied in women by cessation of the genital functions. The psychosis develops when there exists concomitantly, in either sex, any cardiovascular or other disorder which impairs the functional efficiency of the brain as the organ of mind. (Author's definition.)

ETIOLOGY AND PATHOLOGY.—While normally involution should be attended with no morbid phenomena other than those due to advancing age, graying of the hair, decline of physical virility, etc., in involutional melancholia, which is more frequently observed in women (about 60 per cent.) than in men, there exist in both sexes more or less marked degenerative changes in the

cardiovascular system, the kidneys, and also in the cerebrum, the cortical cells, their deeper neuroglia, and the motor tracts. All the endocrin organs may also, and often do, show lesions, especially sclerotic areas resulting from interstitial hemorrhages dating back to diseases of childhood. Emotional stresses due to grief, suffering, fright, deprivation, etc., as frequently observed during the World War, particularly in neuropathic subjects, are prominent etiological factors.

From my viewpoint, involutional melancholia and other climacteric disorders are not due to the involutional process *per se*, but to the concomitance of pathological conditions of various kinds, particularly those found in the cardiovascular and renal systems. Hence the inability of observers so far to connect definitely the symptoms with the menopause.

No definite connection between any of the symptoms of the so-called depression and the ovarian function was determined in 14 cases of involutional melancholia studied by the writers. In all, however, the injection of **ovarian extract** caused a drop of the diastolic blood-pressure and in 11, a drop of the systolic pressure; 10 patients gained weight; 6 slept and ate better; menstruation returned in 1 after an absence of 17 months, while 8 showed a rise in the percentage of eosinophiles. All underwent a noticeable improvement. Strecker and Keyes (N. Y. Med. Jour., July 5, 1922).

As I interpret the process, the onset of melancholia due to these pathological factors coincides with the diminution of endocrin activity which, as shown in the illustration opposite p. 146, Vol. II, depicting the adrenals, occurs normally in both sexes. In women, the menopause supervenes because of the inability, when the

endocrin glands attain a certain stage of involution, to carry on procreation. In man, the climacteric has no such purpose, since the testes continue to function throughout life, and it manifests itself purely as an expression of endocrin debility when, as in women, some cardiovascular or other disease tends seriously to impair the cerebral circulation. Even at best, when melancholia does not occur, we witness in both sexes various neurotoxic disturbances, irritability, mental unrest, nausea, arthritic pains, etc., and cardiovascular phenomena such as "palpitations," vertigo, heat flushes, congestive headache, etc.

The connection between the adrenal functional decline and the involution of the genital system becomes plain when, as I have pointed out, it is recognized that the adrenals are the source of the lipoids, both lecithin and cholesterol, as well as of the oxidizing substance, adrenoxidase, found in the interstitial cells and corpus luteum. It is, in fact, because of this direct trophic connection between the adrenals and the genital apparatus that the adrenals influence so markedly, both in the male and female, the development of the sex organs and the so-called secondary sex characters.

Involucional melancholia, which constitutes but 3 to 4 per cent. of all mental diseases, occurs, then, not as a result solely of the involucional process itself, but also of the simultaneous presence of conditions, cardiovascular lesions especially, which reduce or impair the functional activity of the cerebral tissues, but the morbid effects of which do not manifest themselves in a clearly defined manner until the general depression caused by the period of involution is initiated.

SYMPTOMS.—All the symptoms of involucional melancholia bespeak the presence of a general functional enfeeblement. There is more or less asthenia, sometimes profound lassitude, anorexia, loss of memory and of mental capacity to work, coldness of the extremities sometimes reaching to the point of numbness and cyanosis, a weak and perhaps irregular pulse, and a subnormal temperature. The general nutrition is more or less impaired, the emaciation being sometimes surprising. A low blood-pressure, edema of the legs, profuse sweating due to relaxation of the sweat glands, sluggish and widely dilated pupils, and graying of the hair, all typify the self-evident deterioration which underlies the psychic phenomena.

The mental symptoms are usually quite in keeping with this physical depression. The patient relaxes her hold upon things in general, her usual interests, and neglects her personal appearance, becoming slouchy and generally indifferent or apathetic. Hypochondrical delusions may then appear, the trend being toward self-accusation of sins or acts committed, accentuated with a sense of deep unworthiness even of the food, the clothes, etc., she is given. The despair may be such as to suggest suicide. She may then become restless and excited, pulling her hair, wringing her hands, the frenzy of excitement being often a precursor of suicidal attempts, impulsive violence, and destructiveness.

Phenomena recalling catatonic dementia precox are not infrequently observed, catalepsy, stereotypy, automatic movements, unapproachability, mutism, and negativism being the more evident manifestations. Usually

there is slowness of speech, with poverty of thought, considerable repetition, and monotonous delivery. This, however, may be replaced, during a period of excitement, by rapid and free delivery.

Some patients display a morbid fear of future events, overwhelming catastrophes, earthquakes, floods, and famines being preferred topics. Yet, perception is seldom impaired, though hallucinations and delusions are frequent; but judgment is defective, resulting in intense fear and severe mental anguish.

In the normal menopause the symptoms present opposite characteristics. The blood-pressure is often above normal and the familial symptoms, heat flushes, irritability, etc., tend to denote erethism instead of depression, as will be shown with more detail when the treatment of the involutional melancholias is considered.

PROGNOSIS.—Even with its pathogenesis and its connection with the endocrin glands as little understood as it has been, the proportion of recoveries is about 40 per cent., the remainder dying from exhaustion, intercurrent diseases, or suicide, which is more frequent in this than any other mental disorder. A better understanding of the preventable progress of the causes of deterioration will, it is hoped, reduce this high mortality, the chances of recovery being greatly increased by familiarity with the marked influence of the endocrin glands over nutrition, including that of the brain.

TREATMENT.—The treatment of involutional melancholia as given in text-books of psychiatry is of the usual kind, purely precautional and symptomatic: **Supervision** to prevent

suicide, **tube-feeding** if needed, **rest in bed** to allay agitation, or **hydrotherapy**; warm drinks on retiring and hypnotics of the **barbital** or **trional** type to procure sleep; but any effort to cure the malady by preventing the inroads of the pathogenic process may be said to be virtually *nil*. In the light of the personal views submitted and the data furnished by empirical opotherapy, it is possible to obtain considerable remedial assistance.

The stigmata of arteriosclerosis having been discerned in a given case, efforts should be made to reduce as far as is possible what obstruction the arterial lesions offer, by dissolving any calcareous deposit which the lesions contain. This may be done by administering desiccated **ovarian gland**, because of the property of the lecithin its interstitial glands contain to dissolve otherwise insoluble calcium deposits in the vascular system. It is important, however, to avoid defatted glands, which are inert, a fact to which are due the poor results recorded by various observers. The action of ovarian gland is markedly increased by **thyroid gland** given simultaneously. A capsule containing 5 grains (0.3 Gm.) of ovarian gland and $\frac{1}{4}$ grain (0.016 Gm.) of thyroid, three times daily, will usually lower the blood-pressure noticeably within three weeks, and restore more or less the normal *vis a tergo* motion of the blood toward the cerebral cells, and, simultaneously, their normal blood-supply in proportion.

This treatment also aids cases in which the systolic tension is high but no serious stigmata of arteriosclerosis can be discerned, the high tension being due to irritation of the vasomotor center by toxic waste products.

In the normal menopause, pseudo-psychopathic irritability, unreasonable excitability, querulousness and general crankiness, and even kleptomania, may appear. In such cases, which as a rule suffer abnormally from heat flushes, there is loss of balance between the normal proportion of lipoids, the lecithin occurring in excess to favor the hydrolysis of toxic wastes. The flushes are in reality but exacerbations of antitoxic activity. In such patients, in whom the blood-pressure is also high, **corpus luteum**, owing to its cholesterol content, should replace the lecithin, along with **thyroid gland** in the same small dose, $\frac{1}{8}$ grain (0.008 Gm.). While the toxic wastes are less actively hydrolyzed by this measure, the exuberant action of the lecithin is kept within normal control by the inhibiting action of the cholesterol.

It should be remembered that the cessation of menstruation limits the elimination of the lipoids, and that their normal quantitative physiological equipoise is often disturbed. This accounts for the excess of cholesterol observed in most cases of high blood-pressure, and which exemplifies the normal method of inhibiting the lecithin and restoring the vasomotor balance. Hence the great value of **corpus luteum** in the menopause, provided a satisfactory preparation is employed. In some instances, it will act more promptly and satisfactorily when injected intramuscularly.

PARANOIA.

SYNONYMS.—*Paranoid state; chronic delusional insanity; monomania; progressive systematized insanity.*

DEFINITION.—Paranoia is a progressive psychosis in which per-

sistent delusions, religious, political, amorous, litigious, etc., are erected on an apparently logical foundation, and which in many instances are of such a nature as to foster criminal attempts on the lives of others. It is apparently independent of any direct pathogenic influence of the endocrin organs. (Author's definition.)

ETIOLOGY AND PATHOLOGY.—Heredity is the dominant morbid factor in practically all cases. While no specific pathological changes have been found in the brain, asymmetry of this organ, anomalous conformations of the convolutions, and vascular anomalies, coupled with malformations of the skull and palate, have often been described. Paranoia occurs more frequently in males than in females, but in both sexes the unmarried distinctly predominate. It seems, however, to be related pathologically to neurasthenia, a fact which harmonizes well with its exciting causes, to wit: Prolonged mental or physical strain, physical or mental shock, acute diseases, and other debilitating mental stresses. There are, however, in addition, various manifestations which bespeak defective organization: Eccentricity, with perhaps precocity in one or more directions, but associated from childhood with morbid shyness, irritability, and mistrust.

It should be borne in mind, however, that many disorders may include paranoiac symptoms. Such disorders are alcoholism, cocaineism, senility, epilepsy, Huntingdon's chorea, and dementia precox.

SYMPTOMS.—The earlier signs of the disorder in its active stage tend towards hypochondria, sullenness, and moroseness, interspersed with

periods of irritability and aloofness. The melancholia is sufficiently deep at times to suggest suicide. This mental attitude is attended with loss of ability to carry on the usual avocations, a state of things which finally proves detrimental and perhaps disastrous to the patient's interests. The mental disorder then manifests itself in the form of delusions concerning the responsibilities incurred, his friends becoming the butt of his reproaches. He is primarily suspicious, and delusions of persecution cause him to interpret inconsequential incidents as ill omens, and to transform him into the persecutor of the persons he suspects. The members of his family may become objects of distrust and enmity, and as his tendency is to keep his mental distress secret, his hallucinations may assume a dangerous form, generally recognized as the stage of systemized delusions of persecution. Prominent persons in the political world, religious bodies or denominations, societies such as the Masons, etc., may thus become suspected agencies of destruction, pursuing him to destroy him.

His mind remaining clear, even though he is unable to realize the unfoundedness of his ideas of wrong in others and the groundlessness of his persecution of them, he is able to devise and carry out successfully dastardly crimes, such as the murders of Lincoln by Wilkes Booth, of McKinley by Czolgosz, of Garfield by Guiteau, and many others. Amorous paranoiacs who pursue the object of their desires until finally committed to an asylum; litigious paranoiacs who sue wealthy persons and corporations on obviously absurd claims; religious paranoiacs who believe them-

selves specifically endowed by God to carry out a program of salvation; jealous paranoiacs, in whom unfounded jealousy is the dominant note; the hypochondriac paranoiac, who imagines himself the victim of some destructive organic disease; the querulant paranoiac, whose victim is often his attending physician, are examples of this class. All paranoiacs, owing to their persecutive trend, are individuals extremely dangerous to society as a whole.

PROGNOSIS.—Paranoia is hopelessly progressive, although some individuals thus afflicted may, where their delusions are not aggressive or harmful to others, be endured by society as "harmless cranks." The possibility of sudden exacerbations attended with danger to the lives of others should always, however, be borne in mind and a warning to this effect given to the members of the patient's immediate family.

TREATMENT.—The medical treatment of genuine paranoia has so far remained sterile of results. The danger to life such patients offer imposes the duty of commitment to asylums unless it is clearly determined that the delusions are absolutely harmless in their trend. Even such cases should be carefully watched, lest a change in the direction of their delusions involve some dangerous or threatening elements.

MENTAL DEFICIENCY.

SYNONYMS.—*Feeble-mindedness; amentia.*

DEFINITION.—The American Medical Association for the Study of the Feeble-minded, on the basis of psychological tests of the relative mental efficiency at various ages, has

formulated the following definition of each of the terms applied to the feeble-minded: In the *idiot*, the mental level is 2 years or below; in the *imbecile*, from 2 to 7 years; in the *moron*, from 7 to 12 years; in the subnormal, from 12 years to 1 more or less below the average adult level. A definition of mental deficiency, therefore, reduces itself to that of a condition in which the mental attributes are more or less below those of a normal individual, as a result of various abnormal conditions, including endocrin disorders, which lower the functional efficiency of the cerebral neurons. (Author's definition.)

ETIOLOGY AND PATHOGENESIS.—The various forms of feeble-mindedness are in reality but degrees of impairment of the brain through intrinsic lesions, or abnormalities of general metabolism in which the brain, through hereditary vulnerability in many instances, takes part. The principal pathogenic factors may be as follows: Arrested development *in utero*; birth injuries, including undue compression of the head by forceps or by the uterus after the injudicious use of pituitrin to hasten delivery; cerebral hemorrhages due to these and other mechanical causes, or to the presence in the mother of a toxemia which raises abnormally both her blood-pressure and that of the newborn; hemorrhages in endocrins of the fetus, notably the cortex of the adrenals, which is relatively enormous in early life (sometimes complicated with purpura); cerebral or meningeal inflammatory diseases, which include autolysis of the inflamed tissues and focal scleroses; head injuries through falls, blows, and other physical traumatisms.

Important as primary factors are various acute febrile diseases, not-

ably diphtheria, scarlet fever, and other disorders of childhood, which early in their course raise the blood-pressure and simultaneously, through the high fever they cause and the correspondingly great digestive activity with which this endows the cellular enzymes, produce tissue autolysis in the thyroid and adrenal glands particularly, and as a result, hemorrhagic foci and subsequent sclerous areas in these organs, with impairment of physical and mental development of the child as end-result.

Additional etiological factors are congenital syphilis, the pathogenic influence of which is exercised mainly upon the endocrin glands, which it debilitates more or less actively; chronic alcoholism in either parent, which acts similarly (especially if conception occurs during drunkenness), causing insufficiency of the same organs, and multiple and too frequent pregnancies, starvation, etc., which occasionally occur as causes. Some of the cases due to hereditary syphilis, and many others in which this disease cannot be traced but in which cerebral lesions, sclerotic in particular, have been caused, show evidences of more or less marked hemiplegia or diplegia. Of outstanding importance in this connection is epilepsy, in which the recurrence of intense cerebral congestion attending the paroxysms gradually evokes deterioration of the cerebral structure as a whole. In fact, sclerotic cases often show spasms affecting certain groups of muscles.

Deficiencies of the organs of special sense may cause apparent mental deficiency in a child who, were it not neglected in this direction, would prove normal. Prominent in this con-

nection is the hearing. A child showing any degree of amentia should be watched and any degree of "hardness of hearing" investigated by an aurist and rhinologist. In most instances the defect will be traced to adenoid vegetations and enlarged tonsils. Snuffles and mouth breathing, and salivation amounting to dribbling, are often due solely to postnasal and faucial disorders, and a complete transformation occurs in the child when they are eliminated by judicious treatment.

The other senses may likewise be impaired and thus reduce the means through which the child acquires the sensory impressions by which its mind is developed. The eyes are prominent factors, and when, as about the fifth year, the educational period begins, any condition which compromises the child's perfect vision, myopia, astigmatism, strabismus, etc., decreases correspondingly its opportunities for mental development. Inability to understand spoken words (word-deafness) or to understand printed or written words (word-blindness) may also be present.

The writer found a relatively large proportion of word-blindness among 736 children in Stockholm backward children. It was of 3 types, visual, auditory, and motor. In the latter group the children seemed unable to form the letter in writing. In 1 family the father and 1 son presented the visual, and another son the auditory, type of verbal blindness. In 33 cases there was a psychopathic tendency, but in 26 the backwardness was due to difficulty in learning to read and write. Yet, most of those in this group were good in mathematics and in writing figures. A. Tamm (*Hygiea*, Oct. 15, 1924).

The rôle of the endocrins in the genesis of mental deficiency may, in

the light of the above data, be reduced to the fact that when they are the seat of lesions due to infectious diseases, toxemias, etc., or debilitated functionally by hereditary syphilis, parental alcoholism, or through maternal prenatal debility, they are unable to supply in sufficient quantities their various secretory products, especially lecithin, adrenoxidase, and thyroiodase, which sustain metabolism in the cerebral neurons as they do in all tissues. The soundness of this deduction is demonstrated by the pathogenic rôle of hypothyroidism in cretinism; of the virtual absence of the adrenal cortex in microcephaly; of the reduced volume and frequent absence of the thymus in idiocy, etc.

PATHOLOGY.—While the physical stigmata are often well marked in idiocy, such is not always the case, particularly where lesions of the endocrins compromising their efficiency have been due to acute fevers experienced comparatively late in the child's formative period. Where the pathogenic factors prevail during or soon after birth, however, deformities of the skull are more or less marked. Of these, microcephaly or abnormal smallness of the cranium, due either to imperfect growth of the brain from intrinsic lesions or deficiency of the adrenal cortex, as we have seen, or, again, to premature ossification of the cranial sutures, is commonly observed. Conversely, many cases of idiocy show a skull larger than normal, often due to hydrocephalus and cerebral hypertrophy. Asymmetry of the skull is also present in some cases.

The face often corresponds with these various forms of osseous distortion, irregularity being often manifest. The palate is high and sharply

arched in most instances, but it is occasionally found broad, irregular in shape, and sometimes cleft. The teeth decay early in most cases, and show the Hutchinsonian type in luetic patients.

In addition to these morphological features and the sclerotic areas previously referred to, there may be found cystic areas of pseudo-porencephaly—localized atrophies marking the site of old hemorrhages. The convolutions may show marked atrophy, localized or general, one-sided or bilateral, including or not, a similar condition of the cerebellum. Rarely some special structure, *e.g.*, the corpus callosum, may be missing. As to the cerebral cells, they may either show embryonic development, be reduced greatly in number, or, indeed, be entirely absent.

SYMPTOMATOLOGY.—To obtain therapeutic results in mental defectives, it is necessary to identify as clearly as possible the causes of the morbid phenomena observed. Of primary importance in this connection is the status of the various endocrins. Although, as we have seen, they are functionally united, it is nevertheless true that while the lesions of which they may be the seat may be due to febrile diseases and other causes reviewed under the preceding heading, one gland is often far more deeply affected than the others. This gives rise to symptoms which denote insufficiency of the gland, but which in reality are an expression not only of the reduced secretion this involves, but also of the impairment of the functions of the other endocrins with which the organ is functionally related. These effects may be briefly summarized as follows:

Thyroid Deficiency.—The thyroid hormone, we have seen, sensitizes the phosphorus-laden lecithin to the action of the oxygen supplied to all tissues by the adrenoxidase. Hence the familiar symptoms observed in thyroid deficiency and in its most advanced types, cretinism (infantile myxedema) and myxedema in the adult: Subnormal temperature, low basal metabolism, sensitiveness to cold and tendency to cold extremities, all with a tendency to obesity, fat pads, and pot belly. The cutaneous tissues being the seat of slowed metabolism and deficient sweat and sebaceous lubricant, the skin surfaces are dry and perhaps scaly, the hair being also more or less coarse and dry, and the nails brittle. The teeth, through defective formation of calcium phosphate, due in turn to defective absorption of the lecithin, are likewise brittle and readily become carious.

As to the mentality of such a subject, the psychic deficiencies, more or less marked, find their ready explanation in the fact that here, as elsewhere, it is the thyroid hormone which activates the cerebral lecithin (cephalin) for the development of nervous energy in the cerebral neurons. Thyroid deficiency, therefore, means a correspondingly marked mental deficiency.

The functions of all other endocrins being slowed, many other systemic abnormalities are more or less evident, *e.g.*, in deficient physical growth, sexual development, etc. These have all been reviewed in my article on JUVENILE ENDOCRINOPATHIES in Volume VI, in the section on CRETINISM.

Thymus Deficiency.—While the cretinoid idiot constitutes a distinct class, it is also true that cretinoid symptoms may be found in feeble-

mindfulness of any type—particularly the senile appearance of the face, creases, the dry skin, coarse hair, and the cutaneous anesthesia. The stigmata of thymus deficiency are especially marked in this connection. This organ, as I have pointed out, serves to supply the phosphorus in the lecithin of its nucleoprotein product,—distributed through its small lymphocytes, which I have termed thymocytes,—which the child requires during the development particularly of its osseous and nervous systems, including the brain.

Hence the fact that in many cretinoid and other idiots or imbeciles we witness more or less dwarfism, due to inadequate growth of the osseous system, with defective development of epiphyses. Deformities suggesting rickets or osteomalacia are also observed, which are due to deficient assimilation of calcium. The thymic lecithin takes part, we have seen, in the building up of calcium phosphate, the formation of which is necessary to osseous growth.

The deficient mental development is likewise due to the insufficient production of thymic lecithin to supply the neurons of the central nervous system during its development. In keeping with this process, there is a low relative lymphocyte count, due to the inadequate formation of these cells by the thymus.

Adrenal Deficiency.—The adrenal cortex in the newborn is relatively enormous when compared with that of the adult. This means that its lipoids—lecithin mainly, and cholesterol—play a correspondingly important rôle in the child's development. But essential in its relations to idiocy is that there is, besides the cortex, the medulla of the adrenals, which sup-

plies the oxidizing agent, adrenoxidase. We thus have united in the adrenals the dominant agents that sustain pulmonary and tissue respiration or metabolism and the vascular tone.

The stigmata of deficiency of the adrenal secretory products are thus clearly accounted for. They are, briefly: Muscular weakness and emaciation, pallor, deficient hair growth, sensitiveness to cold, subnormal temperature—all due to deficient tissue oxidation and recession of the blood mass into the splanchnic area; weak heart action and pulse, low blood-pressure, and constipation due to deficient peristalsis, the result in turn of torpor of the intestinal muscular layer; pigmentation, sometimes limited to bronze areas on the back of the hands, and freckles; mental torpor, slow intellection or even idiocy, particularly where the adrenal deficiency is initiated *in utero*.

Pituitary Deficiency.—As shown by many published cases, tumors, injuries, and other lesions of the pituitary body impair its functional activity. This organ has long been thought to be the source of an internal secretion, but, as I pointed out over two decades ago and as experimental and pathological researches have demonstrated since, it is not a secreting organ, but one in which *nerve energy is liberated for the large nuclei in the tuber cinereum that govern the functional activity of the various endocrins*. Pituitary deficiency thus becomes a result of weakened impulses transmitted by way of the floor of the third ventricle, the bulb, the cord, and then by means of the sympathetic and its connections, to various endocrins, and also to the kidneys, which organs receive sympathetic fibers with the adrenals through the greater splanchnics.

This accounts for the surprising fact that impairment of the functions of the pituitary practically rehearses all the stigmata and symptoms awakened by the various true endocrin glands reviewed above. These evidences, summarized, are as follows: Sub-normal temperature; low blood-pressure; pigmentation (symptoms of deficient activity of the adrenal medulla); muscular weakness and scanty hair growth; in a pre-adolescent case, undeveloped or infantile genital organs (deficient activity of the adrenal cortex); tendency to adiposis; smoothness, but in some cases roughness and dryness of the skin (deficient activity of the thyroid); undersized growth owing to deficient skeletal development and imperfect ossification of the epiphyses (pre-adolescent deficiency of the thymus).

All these stigmata may appear in any form of feeble-mindedness. A backward child, nearly normal in every respect, may owe his difficulty at school to slight endocrin deficiency, shown only, perhaps, by a somewhat rough skin and slight cutaneous anesthesia. Including these milder cases of quasi-normal children, the 150 cases I have treated have shown endocrin stigmata in about one-third (35 per cent.). All were benefited by endocrin therapy.

We have seen that *idiocy* may be due to deprivation of any of the senses, hearing, sight, etc., and particularly to deaf-mutism. These defects may themselves, however, be due to involvement of the central areas connected with them automatically, and may, therefore, occur as symptoms. Defects of taste and smell may also exist, many idiots being incapable of detecting odors. Tactile, painful, and

thermal sensations are often deficient in acuteness, particularly when the functional activity of the endocrins is below normal. Marked cases may even be insensitive to pin-pricks. The instances of self-mutilation observed are attributable to this fact; indeed, idiotic women have borne children without pain.

The newly born idiot does not attempt to suck the breast, owing to deficiency of instinctive reactions. It may die of starvation if not fed by artificial means. It sleeps almost continuously. As idiots grow, their deficient response to nature's call persists, and they continue to soil themselves and their bed. They may be no farther advanced after several years than are normal infants one year old. The voice may be absent or replaced by grunts or an inarticulate cry.

The expression is generally placid and good-natured. The idiot seems often to feel the necessity of guidance, and fawns upon those with whom he comes in contact. At other times, however, especially when his training has been neglected and he has acquired bad habits, his expression may become brutified. In some hypothyroid idiots, the child is not much more advanced than a plant. Fortunately, such examples are rare.

In *imbecility* the powers of perception and comprehension, though extremely limited, do not prevent the patient from learning to walk, attending to the calls of nature and even saying a few words and recognizing animal pictures, figures and letters; being unaware of his condition, however, his animal instincts alone prevail. Self-control is lacking, and the slightest irritation causes an outbreak of

rage with attempts at violence. Masturbation is frequent, and when puberty is reached uncontrolled sexual desire in either sex leads these subjects to commit immoral offenses such as rape and to become sexual perverts. These are the so-called "moral idiots," in whom the dominant factor is total absence of mental control. Imbeciles are often irritable, thievish, brutal, and cruel.

Where the mental deficiency is less pronounced there is greater capacity to learn, but in my experience arithmetic seems to be beyond these patients. Other branches, however, *c.g.*, spelling, history, and writing, seem to be to a slight extent within their reach. Yet, they are not only destructive, but also totally indifferent to suffering in others; they may even enjoy witnessing it and, probably as a sexual stimulus, the torturing of animals. The limits of their capacity for mental development are soon reached, and they seem refractory as regards their brutal tendencies, failing totally to perceive their meaning. Paranoia and dementia precox often develop in such cases. Physically, despite the stigmata of degeneration about the skull, ears, or palate, these subjects may be well developed and otherwise healthy.

A peculiar type of imbecile is that termed *idiot savant*, who shows extraordinary aptitude in arithmetic, music, painting, etc. The "lightning calculators" of shows, and Blind Tom, the pianist, exemplify this type. Conversely, in minds of the first order, that of the great composer Beethoven, for example, opposite conditions may exist, for his inability to multiply the simplest figures, 3 times 36 marks, for instance, is a matter of record.

The total he made it out to be was 224 marks, which he paid to a servant! While music itself is the most sensual of all the arts and does not necessitate superior intelligence, composition does when it is of a high class.

A still higher type of imbecility, in which the individual concerned is often apparently normal, is that designated as *feeble-mindedness*. As the word implies, the mental control of their conduct is deficient in these subjects; they lack foresight and interpret illogically the consequences of their acts; hence the fact that they frequently become thieves and prostitutes. They learn readily and may appear intelligent, their desire to impress their hearers and their unlimited vanity causing them to take great pains to shine and be admired. Soon, however, the ill-management of all they undertake entails failure and leads to their downfall. Some embezzlers belong to this type, their desire to impress others, women particularly, leading them readily to wrongdoing.

The class termed *morons* by the American Association for the Study of the Feeble-minded is placed ahead of the imbeciles, ranging from 7 to 12 years of age in mental capacity. As a prominent statistician has estimated that the United States contain twenty million morons, nearly one-fifth of its population, it is probably true that, as some critics have held, the term includes those subjects who have been deprived of sufficient education to develop their intellect to the normal level. This can hardly, therefore, be deemed a clinical type capable of being improved by medical measures.

DIAGNOSIS.—The recognition of the various forms described is not dif-



ficult. Other deficiencies of a special type, *viz.*, cretinism, Mongolism, adiposogenital dystrophy, and infantilism, described at length elsewhere, are likewise readily identified, so specific are their characteristics.

In all forms, the mental deficiency should be established through comparative age-intelligence ratings or tests which will make it possible, as the treatment and training of a case proceeds, to gauge the mental progress realized. Although many forms of intelligence tests have been proposed, those of Binet and Simon, two French physicians, as revised by Terman, are the ones most used in the United States. They furnish an approximate idea of the mental level of the patient when compared with that of children at different ages, and thus serve as valuable adjuncts to the clinical examination. Special books and various articles, blocks, pictures, etc., are needed to carry them out successfully.

When the patient has reached intermediate childhood, the recognition of mental deficiency is not difficult. The presence of such deficiency during infancy, however, is not easily established unless it be through comparison with the attributes of a normal child. Some years ago Preyer published a study of these faculties as they progressed during the first forty months of a normal child's life. A summary therefrom by Church and Peterson, given in their book on "Nervous and Mental Diseases," is reproduced below. By contrasting the mental development of a supposed backward child with that indicated in the list, an approximate idea of its actual mental status and its development will be obtained.

NORMAL CHILD; FIRST YEAR.—

First month.—Sensitive to light as early as first and second days. Pleasure in light of candle and in bright objects on eleventh day. Hears on fourth day. Discriminates sounds last two weeks of month. Starts at gentle touches second and third days. Sensibility to taste about end of first week. Strong-smelling substances produce mimetic movements at birth. Pleasure first days in nursing, in bath, in sight of objects. Discomfort first days from cold, wet, hunger, tight clothing. Smiles on twenty-sixth day. Tears on twenty-third day. Vowel-sounds in first month. Memory first active as to taste and smell; then as to touch, sight, hearing. Incoördinate movements of the eyes. Sleeps two hours at a time, and sixteen hours in twenty-four. Reflexes active.

Second month.—Strabismus occasional until end of month. Recognizes human voices; turns head toward sounds. Pleased with music and with human face. Sleeps three, sometimes five or six hours. Laughs from tickling at eighth week. Clasps with its four fingers at eighth week. First consonants from forty-third to fifty-first days (am-ma, ta-hu, gö, ara).

Third month.—Sixty-first day, cry of joy at sight of mother and father; eyelids not completely raised when child looks up. Accommodates at ninth week. Notes sound of watch at ninth week; listens with attention.

Fourth month.—Eye-movements perfect. Objects seized are moved towards the eyes. Grasps objects too distant. Joy at seeing self in mirror. Contraposition of thumb in grasping at fourteenth week. Head held up permanently. Sits up with back supported at fourteenth week. Beginning to imitate.

Fifth month.—Discriminates strangers. Looks inquiringly. Pleasure in crumpling and tearing newspapers, pulling hair, ringing a bell. Sleeps ten to eleven hours without food. Desire shown by stretching out arms. Seizes and carries objects to mouth. Consonants l and k.

Sixth month.—Raises self to sitting posture. Laughs, and raises and drops arms when pleasure is great. "Crows" with pleasure. Compares image of father in mirror with original.

Seventh month.—Astonishment shown by open mouth and eyes. Recognizes nurse

after four weeks' absence. Sighs. Imitates movements of head, of pursing lips. Averts head as sign of refusal. Places himself upright on lap.

Eighth month.—Astonishment at new sounds and sights; at imitations of cries of animals.

Ninth month.—Stands on feet without support. More interest shown in things in general. Strikes hands together with joy. Shuts eyes and turns head away when something disagreeable is to be endured. Fear of dog. Turns over when laid face downward. Turns head to light when asked where it is. Questions understood before child can speak. Voice more modulated.

Tenth month.—Sits up without support in bath and carriage. First attempts at walking at forty-first week. Beckoning imitated. Missed parents in absence, also a single ninepin of a set. Cannot repeat a syllable heard. Monologue and hints at imitation (mä, pappä, tatta, appäpā, baba, tätä, pä, rrrr rrrä).

Eleventh month.—Screaming quieted by "sh." Sitting becomes habit for life. Stands without support. Stamps. Syllable correctly repeated. Whispering begins. Consonants b, p, t, d, m, n, r, l, g, k, vowel a most used, u and o rare, i very rare.

Twelfth month.—Pushes chair. Cannot raise self or walk without help. Obeys command, "Give the hand."

SECOND YEAR.—*Thirteenth month.*—Creeps. Shakes head in denial. Says papa and mamma. Understands some words spoken.

Fourteenth month.—Cannot walk without support. Raises himself by chair. Imitates coughing and swinging of arms.

Fifteenth month.—Walks without support. Laughs, smiles, and gives a kiss on request. Repeats syllables. Understands ten words.

Sixteenth month.—Runs alone. Falls rarely.

Seventeenth, eighteenth, and nineteenth months.—Sleeps ten hours at a time. Associates words with objects and movements. Blows horn, strikes with hand or foot, gives leaves to stag, waters flowers, puts stick of wood in stove, washes hands, combs and brushes hair, and other imitative movements.

Twentieth to twenty-fourth month.—Marks with pencil on paper, whispers in reading newspaper. Very few expressions of his are recognizable. Executes orders with

surprising accuracy. Tries to sing and beat time, and dance to music.

THIRD YEAR.—*Twenty-fifth to thirtieth month.*—Distinguishes colors correctly. Sentences of several words. Begins to climb and jump and to ask questions.

Thirtieth to fortieth month.—Goes upstairs without help. Sentences correctly applied. Clauses formed. Words distinctly spoken, but influence of dialect appears. Questioning repeated to weariness. Approximates manner of speech to that of family more and more.

The shape and size of the head are not reliable as far as the skull is concerned, unless it be to recognize the presence of microcephaly, hydrocephalus, and other specific deformities, for the skull more or less rapidly changes its shape as the infant develops. Large ears or a large nose, a pointed jaw, a pointed dome palate may also become normal as the head in general increases in size. Tables supposed to indicate fixed measurements at certain periods of the child's life are, therefore, more misleading than helpful.

Of signal diagnostic importance, however, are paralyses, particularly of a limb or limbs, since they are usually due to some cerebral lesion which hampers mental development and may evoke epileptic attacks. Ataxia, athetosis, and nystagmus are also suggestive, while chorea points to the morbid influence of an excess of toxic wastes. All these features become useful when the treatment is to be considered.

PROGNOSIS.—Even though organotherapy or the use of the active principles of the ductless glands has greatly improved the prognosis, a cure, meaning thereby restoration of the mind to the level of a normal individual, cannot be said to be obtainable at the present time. In my 150

cases I could point only to 3 patients who could be said to approximate this state. They are superior mentally, however, to the moron class and even to the subnormals who are rated above them, the twelve-year level. Yet one of these patients, who would be deemed a bright girl, can only add two simple figures with great difficulty.

In the 147 other patients observed, even with the rational treatment described below, improvement varied from 5 to 60 per cent.—an average, as previously stated, of 35 per cent.,—when compared with mental defectives who had been left untreated.

The patients who showed marked improvement under medical treatment invariably had endocrin stigmata; syphilitic subjects, both imbeciles and morons, came next. The sclerotic, traumatic, epileptic, and sensorial cases, those with disturbed hearing particularly, and paralytic forms, proved the least responsive to treatment. The feeble-minded class, especially, improved.

In this list are not included the backward children of schools, which cannot be regarded strictly as pathological entities, but merely as psychasthenics, clearly traceable to inadequate functional activity of the cerebral system. All such were greatly improved by appropriate medical and endocrin measures.

Well-directed institutional training of all classes of mental deficiency is of very great value. While the general conduct and habits of defectives of a lower order may be greatly improved, some of the higher types may acquire sufficient elementary knowledge and manual dexterity to be made self-supporting.

TREATMENT.—Judging from the results obtained in my own cases, rational endocrinology gives results that the prevailing haphazard use of glandular products has never procured. By “rational” I mean the adjustment of all agents administered to the pathological condition present where possible. Desiccated **thyroid** ($\frac{1}{2}$ grain—0.03 Gm.), for instance, is mainly indicated where stigmata of thyroid insufficiency can at all be discerned, but also as accelerator of thermogenesis, which means activation of the lecithin (and the cerebral equivalent, cephalin). As such it is helpful in all forms of mental deficiency. An important fact to bear in mind, however, is that **lecithin** (3 grains—0.2 Gm.) is deficient in all cases excepting those due to injury or traumatism, to cerebral or focal sclerosis, or to deafness. In the absence of these causes, the cerebral neurons and their nuclei owe their functional torpor mainly to actual absence of this phospholipoid. Again, improvement of the oxidation powers, both respiratory and cellular, favors restoration of the cerebral functions; desiccated **suprarenal gland** (2 grains—0.13 Gm.), which contains both the adrenal cortex and medullary substance, meets this indication. **Epinephrin** or **adrenalin** (5 to 10 drops of the 1:1000 solution) is active in this connection, despite statements to the contrary, provided it is not taken with food but with water. Of value also is desiccated posterior pituitary, officially **pituitarium** ($\frac{1}{10}$ grain—0.0065 Gm.), which contains an aggregate of all the foregoing, its purpose being, as I have pointed out, to supply the large nuclei at the base of the brain with nervous energy. Ad-

ministered therapeutically, however, it influences beneficially the entire cerebrospinal system and the peripheral nerves.

The foregoing dosage is for a child of about 10 years. The **thyroid**, **supra-renal gland**, and **pituitary**, and, if the blood shows a low percentage of hemoglobin and deficiency of erythrocytes, **iron citrate** (1 grain—0.065 Gm.), can be given in a capsule three times daily after meals, while the **lecithin** should be given before meals, or with the food if it causes any gastric disturbance. The preparations of lecithin available in shops will be found described on page 720.

Codliver oil, which contains all the endocrin physiological products, is an efficient adjunct.

Where hereditary syphilis underlies a given case, treatment by **mercurials** and the **iodides** is to be given preference, as the modern arsenicals, **arsphenamin**, **neoarsphenamin**, etc., all tend to depress the functional activity of the endocrin system.

The **open-air life** is essential to the improvement of mental defectives. **Heliotherapy**, applied as it is in the treatment of rickets, is indicated where possible. Most defectives are mentally more active during warm weather, and are improved by **exercise**, which accelerates their thermogenic functions and metabolism, including that of the brain cells.

Mental defectives improve more rapidly in **institutions** than if kept at home owing not only to the educational advantages afforded, but also to the discipline which is necessary in most cases. By far the most satisfactory institutions are those governed entirely by a physician who has at his disposal trained and kindly

caretakers, teachers, and nurses. Lay managers are not sufficiently interested in the medical treatment to give it the rank it should occupy.

Both the medical and educational treatment should be started as early as possible in order to obtain the assistance of the physiological growth processes and favor their trend by supplying the agents which are deficient. Thus, small doses of **thyroid** favor metamorphosis or general development of all tissues, because thyroid activates the physiological lecithin in all cells; **lecithin**, in turn, not only provides the tissues at large with their thermogenic pabulum, but insures growth by supplying the phosphorus required for the development of the skeleton and the cerebrospinal system. Calcium being necessary for the formation of calcium phosphate with the lecithin phosphorus, **lime water** should be administered in milk twice daily.

Habits of cleanliness must be inculcated early, defectives of all ages being very negligent in this respect; they should be taught to walk and the use of their hands at play so as to **cultivate coördination** of muscular movements and **muscular strength**. The **senses** should also be **cultivated** by methods which procure amusement and arouse interest.

As the child develops, an important defect should be borne in mind and corrected as much as possible; it is the lack of attention. This also may be done by cultivation through amusement, games, and interest. Gradually, as the attention improves, educational features may be introduced, such as increasing the child's vocabulary, the distinctness of his spoken words, ideas of weight, length,

form, number, etc. It may be possible to give the child an elementary education, with perhaps **manual training**, which is an excellent method to cultivate both mind and body within their possible limits.

PREVENTION OF FEEBLE-MINDEDNESS.—The manifest influence of the endocrins upon certain forms of feeble-mindedness (those not due to cerebral lesions) when the functions of these organs are interpreted in the light of my views suggested the possibility of preventing mental deficiencies of various kinds by eliminating if possible their fundamental cause in the parents.

A number of years ago (N. Y. Med. Jour., Apr. 1, 1916), though praising the efforts of eugenists on behalf of the child of future generations, I expressed the opinion that physicians *should protect the child of today and the unborn but doomed child of tomorrow*, pointing out that the ductless glands (the adrenals, thyroid, and pituitary especially) were the organs through which vulnerability to disease was transmitted from generation to generation, and that any disease, inherited or acquired, which reduced the functional activity of these glands in a child *impaired correspondingly the development and functional activity of its brain*. I then urged that a campaign should be started having in view the prevention of feeble-mindedness by *supplying through the intermediary of the defective mothers during pregnancy those ductless gland products which would protect their offspring against the various forms of feeble-mindedness due to this cause*. The signs through which the maternal defects could be discerned by the physician were then defined as follows:

Stigmata of thyroid deficiency: 1. Subnormal temperature, cold extremities, due to defective oxidation and metabolism. Tendency to obesity. 2. A doughy, dry skin, with at times cervical or axillary fat pads, scaly skin, and dry brittle hair and nails. 3. Mental torpor.

Stigmata of thymus deficiency during growth: 1. Deficient development of the osseous system, with defective development of the epiphyses and deformities suggesting latent rickets or osteomalacia; undersized stature. 2. Deficient mental development. 3. A low relative lymphocyte count.

Stigmata of adrenal deficiency: 1. Muscular weakness and emaciation, pallor, deficient hair growth, sensitiveness to cold, subnormal temperature. 2. Weak heart action and pulse, low blood-pressure, and constipation due to deficient peristalsis. 3. Pigmentation, sometimes limited to bronze areas on the back of the hands, and freckles. 4. Mental torpor, slow intellection.

Stigmata of pituitary deficiency.—Hypopituitarism being from my viewpoint the expression of pluriglandular deficiency, the stigmata in a case of hypopituitarism are, as recorded by many observers, those of deficiency of all other endocrins collectively: 1. Subnormal temperature; low blood-pressure; pigmentation; muscular weakness, and scanty hair growth. 2. Tendency to adiposis; smoothness, but in some cases roughness and dryness of the skin. 3. Undersized growth, owing to deficient skeletal development.

Engelbach and McMahon (Ill. Med. Jour., July, 1926) have suggested that the basal metabolic rate be taken during pregnancy as an index of the endocrin status of the mother. They found that after the third month of pregnancy the basal metabolic rate was increased by 15 to 25 per cent. when the thyroid was sufficiently active to meet the needs of the developing fetus. They recalled that those gravid women who showed slight enlargement of the thyroid were less subject to toxemia than those who did not.

Careful examination of a pregnant woman for any endocrin stigmata should form part of the routine examination. If none can be detected and a basal metabolism determination

after the third month of pregnancy is from 15 to 25 per cent. above normal, the likelihood that the child will be normal is practically certain—provided that the various other causes of mental deficiency described under ETIOLOGY are not allowed to prevail—the careless or free use of pituitrin especially.

Where maternal endocrin stigmata are found and the signs of deficiency of one of the glands predominate, the use of that gland therapeutically as dominant constituent of the combination employed will procure the best results. In any case, however, **thyroid** should be employed in addition to any other agent used, to insure adequate activation of thermogenesis and metabolism. Where any sign of latent rickets occurs in the mother, **lecithin** (3 grains—0.2 Gm.) is indicated, or in mild cases **pituitary gland** (both lobes) in 2 grain (0.13 Gm.) doses, twice daily. The latter is to be preferred, for lecithin tends to promote obesity, and overgrowth of the fetus.

The pregnant mother having been carefully treated organotherapeutically according to the stigmata she presents, the infant will be supplied *in utero* with the secretions required to build up, not only its osseous, muscular, cardiovascular, cutaneous, and other systems, but likewise its cerebrospinal and peripheral nervous system. It will also be prepared to develop normally after birth, provided that the treatment be continued.

An example of the results attainable in this direction is afforded by the instance of a family in which all the children, three in number, were idiots. Definite landmarks of glandular deficiencies having been found in the mother, she was placed under appropriate glandular treatment to protect a

fourth child expected in about six months. This baby at birth was normal, and when heard from last, was a fine bright boy of five years, normal in every respect. Since then, similar results have been obtained by various physicians.

SPECIAL FORMS.—Aside from the general subject of mental deficiency considered in the foregoing pages, there are other disorders which present distinct characteristics: **Cretinism**, due essentially to thyroid insufficiency; **adiposogenital dystrophy**, which includes feeble-mindedness among its symptoms in many instances, and the various types of **infantilism** also related etiologically to the endocrins, and which occasionally show symptoms of backwardness. All these types have been considered under JUVENILE ENDOCRINOPATHIES in Volume VI.

Judging from the comparatively large number of cases of **Mongolism** I am called upon to treat, this type of idiocy appears to be increasing. It was deemed advisable, therefore, to consider it at length hereinafter.

MONGOLISM.

SYNONYM.—*Mongolian idiocy.*

DEFINITION.—A form of idiocy in which the patient, by reason of his slanting eyes, resembles a Mongolian of the Coolie type, and due in part to deficiency of phospholipoids during fetal development and after birth, as well as to deficient activity of the thymus as a source of the same lipid, lecithin. (Author's definition.)

SYMPTOMS.—Aside from the Mongolian eyes referred to above, the slanting being due to the fact that the outer canthus is higher than the inner, the nose is small and squatty, suggesting some kinship to cretinism, while the malformed external ears

and other signs have suggested to some authors a form of atavism towards simian morphological kinship.

Defective bone development is marked, as indicated by the low average stature, due to shortness of the long bones, and the stubby, square hands with incurvation of the little fingers. The skull also shows participation in the morbid process, the anteroposterior diameter being almost equal to the transverse, a fact which causes the head to appear round. The circumferential measurements are invariably below normal, sometimes $2\frac{1}{2}$ inches, the average being, in 26 cases studied by Muir, $1\frac{1}{3}$ inches. Closure of the fontanels is delayed. Additional evidence as to defective bone nutrition is shown by the frequency of rickets, sometimes discernible at birth. This applies also to defects such as club-foot, dislocation of the hips, palatal deformities, etc. The teeth, surrounded by hypertrophied gums, are irregular and undergo caries early. They appear late, the second dentition being also delayed.

The presence of Hutchinson's teeth in Mongolism does not indicate congenital syphilis. In 155 cases, the Wassermann test on the blood was performed routinely, but in not a single case was it found to be positive. Mebane (*Amer. Jour. Dis. of Childr.*, Oct., 1924).

While the skin is smooth in some, in others it is dry and rough, as in cretinism. The hair is usually soft and straight, but occasionally coarse. As in the cretin also, the tongue is thick and heavy, but it presents, in the Mongolian idiot, characteristic transverse fissures and greatly hypertrophied papillæ, the organ being thus rendered very rough. Subnormal temperature, with marked sensitive-

ness to cold and sluggish circulation, is also commonly noted.

The development of the entire musculature is considerably delayed; muscular power likewise. The ligaments are so loosely strung, in fact, as to permit the freest movements and contortions; the fingers, for example, may be bent backward upon the dorsum of the hand with the utmost ease. And yet all muscular movements are clumsy, being poorly co-ordinated—a feature which, in affecting the lingual musculature, contributes considerably to the retardation of speech. The ocular muscles are likewise involved, as shown by the frequency of strabismus and nystagmus in these patients. This applies also to the abdominal muscles, hernia, especially the umbilical form, being common. The abdomen itself is usually large and distended, owing to relaxation of its musculature.

The mental characteristics of the Mongolian idiot are specific in that, while more or less mentally dwarfed, he is usually amiable and affectionate, and shows a predilection for mimicry and music. While lively in many instances, cheerful and fun-loving, he is usually tractable and takes part readily in the play of other children if permitted to do so.

The Mongolian features are often recognizable at birth or soon thereafter, thus affording an early opportunity for judicious treatment. The Mongolian infant is usually well behaved, so good, in fact, as to elicit comment and favorable comparison with the average lusty baby. Small at birth, it develops about one-half as rapidly as the normal child, but its emotions are still slower in developing, its powers of observation being

often *nil* during the entire first year. It will lie in bed placidly hours at a time, apparently quite contented.

ETIOLOGY AND PATHOLOGY.

—Various facts tend to indicate that Mongolism, as I suggested a number of years ago (1915), is due to deficiency of the phospholipoid lecithin contained in the nucleins supplied by the thymus during the development of the child, and before birth derived from the maternal supply. In other words, from my viewpoint *deficiency of lecithin plays the same rôle in Mongolian idiocy as deficiency of thyroiodase does in cretinism.*

The rôle of the thymus in the etiological process has been emphasized by autopsies in a large number of idiots. Among 292 instances of mental deficiency studied by Bourneville and Katz, the thymus was absent in 216 of the cases. In 408 non-myxedematous (*non-cretinic*) idiots from 1 to 5 years of age, the thymus was absent in 304, according to Morel. Lange and Dicker, Garrè and Lampé found the thyroid normal in many cases of idiocy, whereas the thymus was very small.

While the foregoing data do not indicate specifically that Mongolian idiocy is due to deficiency or absence of the thymus, the symptomatology of the disease points significantly to deficiency of phosphorus. This is sustained by various collateral facts, which come to light when the source of the Mongolian facies is sought.

A feature of all these little patients is that they look alike to such a degree in all countries that they might be taken for members of a single family. As suggested by a personal study, the peculiar Mongolian facies is not a result of mere hazard, but of

a biochemical defect, *viz.*, a deficiency of organic phosphorus intake. In the Asiatic coolies the main food consists of polished rice, the milling of which deprives it of its pericarp, which contains its soluble compound rich in phosphorus pentoxide. That idiocy should not occur in these coolies is accounted for by the fact that while thousands of years have caused the organisms of these individuals to adjust themselves to the limited phosphorus intake imposed by the practically universal use of polished rice by them, they also use fish in their diet in sufficient quantities at least to maintain a working asset in their tissues. Suggestive in this connection is the fact that well-to-do Chinese and other Mongolians who are able to obtain a varied diet seldom have the true "Mongolian" features—the slanting eyes in particular. Rice here typifies but one of the foods which is poor in phosphorus, as is well known, and thus exemplifies a wide range of deficiency food factors. But few if any of these foods are used as virtually the sole article of food. Despite published statements to the contrary, Mongolism is not limited to the Caucasian race.

The writer found up to 80 different kinds of malformation in cadavers of Mongoloid idiots. The brains show the brachycephaly formation of Chinese brains, only in a more pronounced form—"more Mongolian than the Chinese." The weight of the cerebellum was always subnormal, and a bunch of nerve tissue—gray matter—was found on the median side of the flocculus or *tuber flocculi*. Gans (Nederl. Tijdsch. v. Geneesk., Aug. 22, 1925).

Recently pathological changes have been found in the base of the brain in the region to which I pointed in 1907 as a path for nerves from the pitui-

tary body to the various endocrins, the adrenals, thyroid, thymus, etc. By impairing the impulses to these various organs, such lesions explain not only the deficient absorption of lecithin due to incompetence of the thymus, but also the incompetence of other endocrin structures.

In 23 out of 24 non-selected cases of Mongolian idiocy the writer found that the radiographs of the skull showed a peculiar deviation from the normal in the anterior portion of the fossa pituitaria in the shape of an excavation under the anterior clinoid process. The Mongolian type physically presents, as a general rule, a combination of subnormal and disproportionate body growth, combined with genital maldevelopment. Timme (*Med. Rev. of Reviews*, Aug. 25, 1925).

The writer was unable to find any consistent change in the sella turcica in Mongolism that could be considered definitely pathologic; he is also convinced that fairly extensive enlargement of the pituitary body may occur without involving the sella. Clift (*Amer. Jour of Roentgenol.*, July, 1922).

After a study of 345 cases, the author concluded that syphilis and heredity played no rôle in the pathogenesis of Mongolism. The dominant finding was a hypoplasia or a defect of development of the base of the cranium, of the gyri recti, and of the floor of the third ventricle. This he attributes to undue compression of the fetal head in a narrow annion, the innermost of the fetal membranes. Van der Scheer (*Paris méd.*, Sept. 26, 1925).

In the white or Caucasian race the deficiency of lecithin or organic phosphorus is due, from my viewpoint, to such conditions as multiple pregnancies, advanced age of the parents (the mother, in particular), and other debilitating states, such as alcoholism, tuberculosis, syphilis, gout, a violent emotion, and neuroses in the

near or remote parentage, all of these rendering the mother unable, as I interpret the process, to supply her developing fetus with a sufficient aggregate of the phospholipoid lecithin to meet the needs of its cerebrospinal system, in particular, and of all its other tissue cells. Hence the dominant note in the little patients—the idiocy.

Many cases of Mongolism occur as offspring of couples that have been prolific, the little Mongolian being the last brother or sister of many normal children. Leeper, for example, in a study of 176 cases of Mongolian idiocy, found that one-half of these subjects were the last born of large families, and that neuroses were common in their ancestral histories. Goddard confirmed this fact after a study of 294 Mongolians. They are also said to occur as the offspring of couples in which there is a marked disparity in ages.

Very little evidence was found by the writer in support of the pre-war theory that Mongolism was due to the mother reaching the end of the child-bearing period. In $\frac{3}{5}$ of 50 cases studied, the father had served in the army or navy in the war, and in nearly $\frac{1}{2}$ he had suffered from shell shock, while the mothers were young and healthy. Dora M. Berry (*Brit. Jour. of Childr. Dis.*, Oct.-Dec., 1924).

The fact that not infrequently one Mongolian occurs in a pair of twins has been attributed to defective germ plasm. But this theoretical explanation is rendered unnecessary by the fact that one fetus may take up his normal supply of phospholipoid, while the other may not, thus being born in a defective state, as is frequently observed in animals, the imperfect product of which is termed a "runt."

The writer found records of 9 cases in which 1 of a pair of twins presented Mongoloid idiocy, and personally observed 5 similar instances. The twins were of opposite sexes in all but 1 instance. A bivitelline pregnancy may be assumed. In 2 further cases the sexes were the same, and both twins were of the Mongolian idiot type. These 2 cases sustain the assumption of an endogenous origin, either the ovum or the spermatozoön or both being abnormal. He inclines to incriminate the ovum, as the mothers were mostly close to the extreme end of the reproductive period, and exhausted by numerous pregnancies. In his cases the women were 35, 41, 43 and 44 years old. T. Halbertsma (Nederl. Tijdsch. v. Geneesk., July 1, 1922).

One of the writer's patients was a girl whose twin brother was healthy. The Loewi reaction was negative, and the Aschner reflex positive in all but 40 cases. Sergeant's "suprarenal white line" could be produced in 75 per cent. The blood-pressure was low, and the coagulation time seemed to be prolonged. Vas (Jahrb. f. Kinderheilk., Dec., 1925).

Another phase of the subject asserts itself in this connection. I have urged for over two decades the importance of phosphorus in our defensive processes. As source of heat (thermogen) when oxidized by adrenoxidase, it liberates the heat energy which activates the bactericidal and antitoxic enzymes of the body at large.

In view of this fact, the Mongolian should, besides showing signs of deficient development of cerebral, osseous, muscular, lymphatic and other systems, also give evidence of defensive inefficiency. That such is the case is shown in various ways. The Mongolian idiot is peculiarly subject to bacterial infections of the tissues most exposed to them, the respiratory and intestinal tracts, the eyes, skin,

etc. He is an easy prey, therefore, to bronchopneumonia, pneumonia, tuberculosis, influenza, and bacterial diseases of the intestinal canal, succumbing promptly under their effects. The twenty-fifth year is reached in but 9.4 per cent., according to Wiggandt.

Deficiency of the phospholipoid lecithin, thus initiated during uterine life, accounts also for the outstanding manifestation—the idiocy. Along with the rest of the body, the intelligence lags behind, owing to deficient development of the organ of the mind.

TREATMENT.—Judging from the number of cases I see, Comby was quite right when he urged a few years ago that Mongolism was more frequent than was generally believed, and deplored the discouraging results of treatment. The latter difficulty has been due mainly to the fact that the one gland essentially at fault in the process has not been clearly differentiated from those organs of the endocrin series which only suffer secondarily.

In reporting 2 interesting cases in one of twins, the writers state: "Sajous, Sr., called attention to the relationship of insufficient functioning of the thymus gland to certain types of low mental development, particularly Mongolian idiocy. One after another, and at times collectively, disturbances of the endocrin glands have been called upon to explain this complex condition." H. Dietrich and H. K. Berkley (Cal. and West. Med., Apr., 1926).

In truth, all endocrin structures are more or less involved in the morbid process, along with all other tissues, owing to the deficiency of lecithin which absence or inadequate activity of the thymus causes. In these conditions the use of **thymus**, or better, **lecithin**, will suffice if graded according to the age and susceptibilities of

the patient, since it will serve to enhance, and possibly bring up to normal, the functional activity of all tissues, including those of the other endocrins. In such cases, the basal metabolism is usually normal, as the thyroid gland is itself normal and the adrenals likewise.

In some instances, however, more or less marked lesions of the thyroid and adrenals (both cortex and medulla in the latter) are discernible at autopsy. Such cases may—though rarely—give a low basal metabolism, usually 15 to 20, with rough skin and coarse hair, *i.e.*, thyroid stigmata. These cases do better when small doses of **thyroid**, say $\frac{1}{8}$ grain (0.008 Gm.), and **suprarenal gland**, 1 grain (0.065 Gm.), are also given three times a day—these doses being used in a child of 5 years.

Lesions of the ductless glands have been reported in some cases of Mongolian idiocy, notably by Lhermitte, Sloboziano and Radovici. In a child $3\frac{1}{2}$ months old the writer found fibrous areas in the thyroid, with reduction of the colloid vesicles in number and size; the adrenals showed an adenomatous hyperplasia (an effort at compensation) of the cortex, contrasting with complete agenesis of the medulla, which was replaced by an angiomatous type of connective tissue. Lereboullet and Schreiber (Paris méd., Nov. 5, 1921).

The basal metabolism was found normal by the writer in 6 Mongol cases. Thyroid treatment had no effect on their basal metabolism, raising it, however, in cretins. G. B. Fleming (Quart. Jour. of Med., Oct., 1922).

In a pathological study of 3 fatal cases no histologic changes were found, while the content of iodine in the thyroid was normal. A retarded ossification of the skull existed in 2 instances. E. Thomas and Delhougne (Monats. f. Kind., Sept., 1924).

While **thymus gland** is indicated in these cases, it is important to bear in mind that some preparations are utterly useless. This is due to the fact that, owing to the bad odor emitted by the tablets after some time, various firms have removed their fatty ingredients. The utter lack of effect in some of my cases led to the conclusion that the fatty substances removed might contain the nuclear active principle, and the active agent in the latter proving to be **lecithin**, I have since used the latter, with considerable satisfaction.

Various preparations of lecithin are now on the market: the **lecithin tablets** of the American Chemical Laboratories, Philadelphia, each of which contains $1\frac{1}{2}$ grains (0.1 Gm.) of the phospholipoid; the French *granular* preparation of Clin or Bouty (imported by Fougere, of New York), and the **lecithin pearls** of M. Wratschko, of New York, and the Harvey-Pittenger Co., of Philadelphia. I have used all four preparations, with satisfactory results. The dose ranges from $\frac{1}{2}$ to 2 grains (0.03 to 0.13 Gm.) according to the age of the little patient. Very small children take tablets, granules, etc., with some difficulty. Chocolate tablets eminently satisfactory for small children have been prepared by the American Chemical Laboratories.

An important adjunct in this connection is **egg-yolk** in the food, beaten up with milk or some form of pap liked by the child. The underlying reason for the great value of this food is that it is rich in lecithin; it is often used by chemists for the preparation of this phospholipoid.

Certain firms, G. W. Carnrick Co. and others, now manufacture **defat-**

ted thymus which is also effective, the dose ranging from 2 to 5 grains (0.13 to 0.3 Gm.) twice daily, with or after meals. Noble P. Barnes (Ann. of Clin. Med., Mar., 1923) and other clinicians obtained beneficial results in Mongolians with thymus gland. Barnes observed that subjects in whom the treatment could be begun early, *i.e.*, soon after birth, did much better than after the fifth year. This coincides with my own observations.

Additional measures of importance are those indicated in the treatment of rickets (*q.v.*, under BONES, DISEASES OF, in Volume II), such as **sunlight** and **open air life**. These children do better at the **seashore** than in the mountains, since a large proportion of them suffer from a patent foramen ovale and other cardiac deficiencies which are not favorably influenced by high altitudes.

The mingling with other children is one of the most important educational procedures. Later, the advantage of a school for atypical children, or better, a private tutor who will take especial pains to study and develop his pupil, cannot be denied. N. P. Barnes (Ann. of Clin. Med., Mar., 1923).

What results may be expected from even the above method of treatment? All that can be said for the present is that **lecithin** has seemed to prove beneficial much more rapidly than **thymus gland**—a fact perhaps explained by the absence of the active agent in some of the preparations on the market, as a source of low average benefit. In my cases **lecithin** has given prompt indications of improvement, but its use is too recent to speak with any degree of confidence as regards ultimate results. Especially should reserve be a feature of the prognosis when we bear in mind

the widespread lesions due to maldevelopment which autopsies have revealed, particularly in the brain.

In cases taken at random, out of 150 cases of Mongolism that were examined post mortem, the brain showed reduction in number and simplicity of the convolutions; no secondary convolutions; shallow sulci; cerebellum small and more exposed. All the brains were symmetrical; there were no changes in the pia or dura; the lateral ventricles were normal. A patent foramen ovale was found in 7 out of 8 hearts. Brushfield (Brit. Jour. of Childr. Dis., Oct.-Dec., 1924).

PROPHYLAXIS.—In 1916, I had occasion to state in an address that “the mental and physical states of all pregnant women as regards the functional efficiency of their ductless glands, which may be determined by the stigmata of deficiency of these organs, should invariably be established. If found deficient, organotherapy should be used to protect them against renal disorders and convulsions through toxemia, and also their offspring against imperfect development and mental deficiency.”

This statement has borne fruit in various directions. In the prevention of Mongolism, in the event of pregnancy in a woman who has borne several children, or who herself is much younger or older than her husband, or where on either side there is some history of a debilitating toxemia or habit—the various factors enumerated under ETIOLOGY AND PATHOLOGY,—the use of **lecithin** should be resorted to in the mother, along with **calcium** if there is any sign of rickets in any other of the children, and **thyroid**, if a history of lues or any remote connection with it can be traced.

C. E. DE M. SAJOUS,
Philadelphia.

PUERPERAL ECLAMPSIA (Puerperal Convulsions).—DEFINITION.—Eclampsia is a symptomatic disorder characterized by convulsive or epileptiform seizures that suddenly come on prior to, during, or after labor.

Zweifel reports a case occurring in the third month, but it is generally met with during the second half of pregnancy, and rises in frequency the nearer term is approached. While toxemia manifests itself in some form more frequently, actual eclampsia occurs about once in one hundred pregnancies, and about in the following order: during the latter months of gestation, 55 per cent.; during labor, 30 per cent., and least frequently after delivery, or, during the puerperal period proper, 15 per cent.

SYMPTOMS.—Convulsions may in rare instances appear without warning, but usually symptoms of a pre-eclamptic toxemia may be observed. Olshausen has frequently found severe epigastric pain to precede an attack and lays particular stress upon the sign. Cephalalgia and dimness of vision are commonly noted; edema of the face and occasionally insomnia are persistent signs. The prodromal symptoms occur about in the following order: vertigo, tinnitus aurium, persistent headache, precordial distress, epigastric pains, disturbed vision with total blindness, in some instances, and only blurred vision, or spots before the eyes, in others; general edema.

Systematic examination of the urine not alone for albumin and casts, but also for urea, and a record of the amount of urine passed in the twenty-four hours is obligatory even in those cases in which, although there never

has been a suspicion of renal impairment, the kidneys are nevertheless functionally impaired. *Pari passu* with diminished excretion of urea the risk of toxemia increases, and the most dangerous form of eclampsia—that which develops suddenly, without much premonition and passes into coma and death—frequently depends on urinary insufficiency as regards excretion.

Albumin and casts may or may not be present in the urine, according to whether a nephritis complicates the pregnancy or not. Should the premonitory symptoms be aggravated elimination of urea is defective, as shown by the recognized tests. Insufficiency on the part of the kidneys may be determined by measuring the amount of urine passed in the twenty-four hours and estimating the amount of urea excreted. While albumin and casts are pretty constantly present, they are not necessarily so, as a small percentage of eclampsias occur in the absence of both, so that while frequent urinalyses are essential, the keynote to the situation is the premonitory subjective symptoms, already referred to, the decreased percentage of urea excreted and the persistently high blood-pressure. The persistent systolic pressure of 160 mm. or more should always be regarded as a danger signal. Vascular tension and blood-pressure are apt to be increased except in women of an anemic type; edema, as a rule, accompanies organic renal disease.

The Eclamptic Seizure.—This is characteristic. The wide-open eyes, fixed in vacant stare, soon beginning to roll from side to side; the usually dilated pupils, the rapidly opening and closing lids, twitchings at the

nasal alæ; the clonic convulsions accompany, ordinarily, the first seizures. The convulsive movements first appear about the mouth, then extend rapidly to the arms, body, and finally to the legs. The heart's action becomes irregular, the face is cyanosed, the breathing stertorous; the patient foams at the mouth and frequently bites her tongue. Soon the convulsions become tonic in character; the eyes are fixed; opisthotonos may occur.

When the disorder appears during the latter part of labor or in the puerperium, there may be but a single convulsion. The first, however, is usually followed by others.

The number of seizures is variable, from 1 or 2 in mild cases to as many as 125 in the twenty-four hours having been noted in the more severe forms. The duration of the seizures is from a few seconds to two minutes, and the convulsions are always followed by unconsciousness, in some instances the patient not even remembering the attack itself; or else the first seizure merges into coma and ends in death. In rare instances coma may follow a single convulsion from which the patient never emerges; however, death usually occurs only after frequent repetition of the convulsive attacks. Generally, after delivery of the fetus the convulsions cease. Though eclampsia does not frequently develop after delivery, it has, however, been observed in one-third of their cases by Newell and McPherson and to the extent of 23 per cent. by Williams. In these cases the attacks usually follow each other rapidly and frequently terminate fatally.

Marked mental derangement was

observed by Löhlein and Lichtenstein in a number of instances to follow eclampsia. Hemianopsia may appear as a result of the incident cerebral lesions. Visual disturbances, due to albuminuric retinitis, may also be present or may appear as a manifestation of the general toxemia, prompt recovery usually ensuing in the latter cases.

Marked jaundice has occasionally been observed either during or shortly after convulsive seizures and is considered of grave prognostic significance, indicating serious hepatic involvement.

Nature frequently teaches us the line of action—spontaneous abortion occurring and the eclampsia ceasing.

Labor does not always occur in ante-partum eclampsia; the woman may recover and afterward give birth to a dead or macerated fetus, or carry a living child to full term.

During the eclamptic seizures the urine usually shows signs of renal insufficiency, being diminished in quantity and frequently almost entirely suppressed. Various types of casts may be observed microscopically in great abundance, the hyaline and granular varieties predominating. Epithelial casts may also be found, as well as isolated renal cells, while blood is nearly always present. Hemoglobinuria may also occur.

Albuminuria is pronounced and almost constantly present. The high albumin output is only temporary, however, falling within thirty-six or forty-eight hours after delivery, and then rapidly disappearing, though some cases may show traces for weeks. That high-grade albuminuria does not necessarily indicate profound renal lesions, may be gathered

by the fact that in several cases which have come to autopsy only a mild degenerative nephritis has been observed.

The total nitrogen of the urine is markedly diminished in eclampsia. Urca is reduced and there is a relative increase in the amount of the amino-acids; creatinin, uric acid, etc.

During convalescence the urine usually returns to a normal condition.

The chief chemical blood findings in eclamptics are: High uric acid; markedly increased lactic acid; decrease in CO₂-combining power, sometimes very pronounced; tendency to hyperglycemia, often associated with high inorganic phosphorus. There is usually no increase in the non-protein nitrogen. Stander and Radelet (Bull. Johns Hopk. Hosp., June, 1926).

During the seizure there is usually an increase in arterial pressure, with a full and bounding pulse, which, however, is weaker and more rapid in the more severe cases, and becomes more compressible and filiform with each succeeding convulsion. The temperature usually remains normal, but may rise considerably from the onset of the attack, falling rapidly as improvement takes place.

In occasional cases the convulsions are absent, the patients dying in coma and autopsy showing hepatic and renal lesions.

The victims of nephritis who become pregnant rarely go to term, but abort a dead fetus, the result of interstitial alterations in the placenta, or else require therapeutic abortion.

Eclampsia, as observed by Maygrier, may also occur in false labor accompanying extra-uterine gestation, or be associated with hydatidiform mole, as witnessed by Falk and Sitzenfrey, which would indicate

that the metabolic processes of the fetus are not etiological factors in eclampsia.

DIAGNOSIS.—Eclampsia is usually easily recognized, but may be confounded with acute strychnine, phosphorus, or nitrobenzol poisoning. Such instances are rare, however, and the possibility of error may be obviated by a careful history of the case. Uremia, epilepsy, acute yellow atrophy of the liver, and even hysteria may simulate eclampsia and must be borne in mind and excluded before a positive diagnosis is made.

ETIOLOGY AND PATHOGENESIS.—The eclamptic attacks have been ascribed to various morbid conditions, *c.g.*, the entrance of fetal or placental elements into the maternal circulation; poisoning by substances formed or retained in the placenta; an anaphylactic reaction; a toxemia of mammary origin, and toxics derived from maternal or fetal metabolism. The bulk of evidence tends to favor the latter view, *i.e.*, that the spasmogenic poisons are of both maternal and fetal source, probably of metabolic origin. No single toxic agent has however, been isolated. There coexists hepatic insufficiency, renal insufficiency, skin inactivity, etc., with resultant accumulations of toxins.

The writers found 2 toxic bodies in the serum of eclampsia patients, the 1 inducing a slow kind of intoxication in animals, and the other, a sudden, rapidly fatal disturbance with convulsions and features suggesting anaphylactic shock. A small preparatory dose of the same eclamptic serum, or addition of pilocarpine, protected against the latter type of intoxication. Injecting 0.005 Gm. ($\frac{1}{12}$ grain) of **pilocarpine hydrochloride** in a woman who had had 9 convulsive seizures, they witnessed no

further recurrence of the convulsions—a result ascribed to modification of vagosympathetic tone. Lévy-Solal and Tzanck (*Presse méd.*, Aug. 1, 1923).

PROGNOSIS.—The prognosis is always serious, the maternal mortality averaging from 20 to 25 per cent., and that of the fetus from 33 to 50 per cent.; Stroganoff, however, has reported a maternal mortality of only 2.6 per cent. in a series of 300 cases, but this is exceptional.

During the preceding 30 years, at the New York Lying-in Hospital, there were 203 deaths in 879 convulsive cases, a mortality of 23 per cent. After 1918, among 147 patients with antepartum and intrapartum eclampsia, only 23 died, a mortality of 15 per cent.; during this period the treatment by large doses of morphine, with a more conservative method of delivery (accouchement forcé having been abandoned), was employed. A. B. Davis and Harrar (*Jour. Amer. Med. Assoc.*, July 24, 1926).

The condition of the pulse and temperature is of considerable prognostic value. A fair quality of pulse between attacks would indicate a favorable outlook, while if weak, rapid, and thready, a fatal issue may be looked for, especially if combined with a high temperature. High arterial pressure, if persistent, is also of serious import, even when there is improvement of the other symptoms. Complete anuria and inability to sweat in a hot pack is of ominous import. Apoplexy, paralysis, and edema of the lungs are all grave complications. The death of the fetus favorably influences the prognosis in intrapartum eclampsia, the convulsions usually ceasing soon afterward.

TREATMENT.—The treatment of eclampsia may be considered under the following headings: (1) Prophylactic; (2) medicinal; (3) surgical.

Prophylactic Treatment.—The preventive measures, during pregnancy, are of paramount importance. Strict attention must be given to the various hygienic measures, including elimination through the various channels—not diuretics for already overtaxed kidneys, but dilution of the urine by the **free use of water**. Elimination through other channels should also be the rule. With this end in view, every pregnant woman should place herself in the hands of a physician, or, if unable to do so, visit regularly a hospital dispensary, for observation and treatment. With proper hygiene, but few toxic or non-toxic patients, in the absence of organic kidney or liver disease, develop eclampsia.

Of 45 patients who received **magnesium sulphate intravenously** 1 or more times in addition to the usual pre-eclamptic treatment, in an attempt to prevent convulsions, only 6 developed convulsions; of these, 4 had but 1 injection. Lazard, Irwin and Vruwink (*Amer. Jour. Obst. and Gyn.*, 1926).

The principal **hygienic measures** consist of keeping active the sudoriparous glands by **regular bathing**—the tepid bath in the morning or the hot bath in the evening—and by **regular moderate exercise** daily in the **open air**,—preferably walking or motoring. The **diet** should be largely fruit and vegetable, with restriction of nitrogenous food, especially in the later months, and liquid diet only, consisting largely of alkalized **milk**, if albumin appears in the urine or any toxic symptoms develop. The bowels should be kept active with the **fruit diet** and one of the **laxative mineral waters**, administered in alternation with **sodium phosphate**.

It is not sufficient to examine the

urine occasionally or regularly for albumin, but, in addition, to note carefully the presence of any of the subjective premonitory symptoms, previously referred to, and, in the event of their existence, have a specimen of urine submitted for analysis immediately, which analysis shall include the test for albumin and casts, the quantitative test for urea and the amount excreted. An analysis of the urine today may indicate a normal condition and tomorrow the patient may have convulsions, although this is the exception and not the rule. The blood-pressure should be taken at regular intervals.

Hyperacidity of the secretions is frequently present in the early months as well as the later months of pregnancy, and often becomes intensified prior to the development of the prodromal symptoms of eclampsia, as noted by highly acid urine and acid gastric eructations. This condition of acidosis is the result of faulty metabolism with coexisting hepatic insufficiency, and calls for alkalinizing of the secretions with some remedy or remedies that will not only overcome the acidity, but stimulate the hepatic functions also; *i.e.*, **sodium bicarbonate** and extract of **rhubarb**, combined with very small doses of **nux vomica**, given preferably before meals.

Where, notwithstanding these measures, the evidences of organic kidney disease become intensified, or where, these evidences lacking, the symptoms suggestive of impending eclampsia develop, time for action has come, justifiable delay having reached its limit. In the past and even today expectancy has been and is too often the cause of untoward results.

With the exception of the fulminating type of eclampsia—where art almost always fails, it may be stated that prompt action, of the nature to be described, will, in the vast proportion of cases, prevent the development of eclampsia.

Medicinal Treatment.—In the presence of the prodromal symptoms of eclampsia, rigid adherence to the various **hygienic measures**, especially the **diet**, elimination, and alkalinizing the secretions, are of paramount importance. When urinary insufficiency exists, active diuretics are contraindicated, while the **taking of large amounts of water by the mouth** is valuable to dilute the urine and render it less irritating to the functionally, if not organically, crippled kidneys. The kidneys may be still further flushed and the secretions alkalinized with the **alkaline-saline solution by enteroclysis**; **sodium carbonate** 5j (8 Gm.), **sodium chloride** 5j (4 Gm.), to the pint (500 c.c.) of water, given by the Murphy drop method; or, the same preparation may be administered once or twice daily as a colonic irrigation.

Grandin suggests that the **ingestion of large amounts of water by mouth** and repeated introduction of warm **normal saline solution** into the bloodstream will accomplish more than any and all drugs together. **Venesection**, carried to the point of tolerance, and then followed by the subcutaneous injection of a **normal salt solution**, has also been recommended. This method need not be confined to the plethoric, but even a weak pulse and profound coma do not contraindicate its use, for the rapid introduction of the warm salt solution following venesection counteracts the

effects of bleeding, filling the vessels and stimulating the heart.

Serum treatment, while of value in some early toxemias, has been disappointing in the pre-eclamptic state and for the attack. Eight or 10 c.c. of blood-serum from a Wassermann-tested pregnant woman at or near term or during labor are injected subcutaneously. The serum may likewise be made from healthy placental tissue.

Serum from recovered eclamptics, 40 to 160 c.c., used in 10 cases—8 antepartum and 2 postpartum. To 3 it was given intravenously, with no reaction and prompt improvement; to the others, intramuscularly, fever following. Four had no more convulsions after the serum, while 5 had but 1 or 2 convulsions. J. J. McMahon (Amer. Jour. of Obst. and Gyn., Aug., 1926).

The use of **thyroid gland** has been advocated by Nicholson in doses as high as 70 to 80 grains (4.6 to 5.4 Gm.) daily during attacks. It has also been used by others, however, with less favorable results.

The **saline irrigation**—if a number of quarts are used at a time—promotes diuresis and diaphoresis and indirectly enforces intestinal peristalsis, and is indicated alike before and during eclampsia. Where the pulse is full and bounding and the blood-pressure remains persistently high, **venesection** is sometimes justifiable while the toxemia is being treated with the **alkaline-saline solution**, providing that, if before delivery, the alkaline-saline solution be given intravenously and simultaneously with venesection, otherwise there is danger of death of the fetus, on account of the slow current of blood-circulation in the sinuses between mother and child. I have

knowledge of a few instances where the fetal heart was distinctly heard just prior to the extraction of a pint (500 c.c.) of blood, and ceased almost immediately afterward. Weak pulse is not necessarily a contraindication to venesection after delivery.

In the author's improved method, the aim is by all means to prevent repetition of the convulsive seizures, on the ground that each one brings the patient nearer death. All sources of irritation are removed and the patient kept secluded in a **dark, quiet room**. To reduce or prevent the seizures, he injects **morphine hydrochloride**, 0.015 Gm. ($\frac{1}{4}$ grain), and gives **chloroform**. In 1 hour's time, **chloral hydrate**, 2 Gm. (30 grains), is also given, in addition to 200 to 250 c.c. ($6\frac{2}{3}$ to 8 ounces) of **saline solution** by rectum and, if the patient is conscious, 100 c.c. ($3\frac{1}{3}$ ounces) of **milk** by mouth. In 3 hours' time, the **morphine** is repeated, usually under **chloroform**; after 7 hours, **chloral hydrate** again; after 13 hours, **chloral hydrate**, 1.5 Gm. (23 grains), if there have been no fits for 12 hours and there are no prodromes, and after 21 hours, **chloral hydrate** again under the same conditions. Labor may be hastened by **forceps** or **extraction** when conditions are favorable. Stimulation by **digitalis**, **digalen**, **caffeine**, **camphor**, etc., is in many cases necessary. **Venesection**, 400 c.c., often relieves the heart and **oxygen** may be given. **Hot-water bottles** are placed about the feet and kidneys. To prevent hypostatic pneumonia, the patient is **turned from side to side**. Under these measures a mortality of only 1.07 per cent. and a fetal mortality of 5 per cent. was obtained. Stroganoff (Jour. of Obst. and Gyn. of Brit. Emp., xxx, 1, 1923).

Venesection.—I limit venesection before delivery to the exceptional cases, for reasons previously stated. Furthermore, if the blood-pressure remains persistently high under eliminative treatment, and the symptoms are sufficiently grave to war-

rant venesection, they are sufficiently grave to warrant looking toward the termination of pregnancy, by rupturing the membranes—one of the best methods to reduce blood-pressure, according to Hirst—which establishes labor later; or the introduction of a medium-sized rectal tube for the same purpose. After delivery, free bleeding by the natural route should be encouraged—without ergot—and venesection practised under the following circumstances: (1) when there is diminution below normal, or cessation of the lochial discharge; (2) recurrence of the convulsions after they have once ceased, and (3) when the symptoms, including the blood-pressure and convulsions, do not respond promptly to the plan of treatment adopted.

Although the use of **veratrum viride** has been highly praised by many American writers, Williams obtained no definite results therefrom, and Summer's statistics show a maternal mortality of 45 per cent.

Englemann employed intravenous injections of 0.2 to 0.3 Gm. (3 to 5 grains) of **hirudin** (leech extract) in a liter (quart) of Ringer's solution, with favorable results in a series of cases. Coagulation of the blood is inhibited thereby and thrombosis prevented. Its use is recommended in severe post-partum eclampsia, but a wider experience is necessary to establish its value in this condition.

Nitroglycerin, in the dosage of $\frac{1}{100}$ grain (0.0013 Gm.) hypodermically, repeated *pro re nata*, will tend to relieve the headache and also the kidney tension. When the convulsions appear suddenly, **morphine**, 1 grain (0.06 Gm.) in divided doses hypodermically, is called for until **chloroform**

anesthesia to the surgical degree is secured; but otherwise opium and its derivatives should not be countenanced, because of their tendency to inhibit secretion from the intestinal canal and from the kidneys, thus defeating the prime therapeutic aim, which is to increase secretion and excretion. Inasmuch, however, as chloroform has a deleterious action upon the liver, Williams advises against its use.

During the attack, in order to prevent the patient from biting her tongue, a **thick cord or folded towel** should be placed between the teeth. During the unconscious stage, no food and as little medicine by mouth as possible should be given, in order to prevent particles from entering the air-passages, instead of being swallowed, and later causing inspiration pneumonia. When consciousness is regained, fluids should be forced. While the plan of treatment must of necessity be varied according to the individual condition, that which has served the writer to the best purpose from the onset of the convulsions, summed up, is about as follows: 2 or 3 grains (0.12 to 0.2 Gm.) of **calomel**, placed on the back of the tongue or 2 minims (0.12 c.c.) of **croton oil** in $\frac{1}{2}$ ounce (15 c.c.) of **olive oil**, if the patient can swallow; if not, it is administered through a stomach-tube. Calomel has the preference, however. A high enema, consisting of $\frac{1}{2}$ ounce (15 c.c.) of **glycerin**, 3 ounces (90 Gm.) of **Epsom salts**, and 6 or 8 ounces (180 or 240 c.c.) of **normal saline**. Following evacuation of the bowels, **sodium bromide**, 40 grains (2.6 Gm.), and **chloral hydrate**, 15 grains (1 Gm.), suspended in 6 ounces (180 c.c.) of **normal saline**, are given by rectum.

The bromide may be repeated, without the chloral, every three or four hours. In the mean time the patient is placed in a **hot pack** for twenty minutes or until moderate diaphoresis is established, but not to the point of exhaustion. Sweating, by reason of having been carried to extremes, has caused the pendulum to swing too far in the opposite direction. An **ice-cap** is kept to the head while in pack, and **water** by mouth is administered freely, if the patient can swallow; if not, **normal saline** or preferably the more **alkaline solution** is given by the Murphy method, at intervals of three hours. Tincture of **veratrum viride** (Norwood), 15 minims (1 c.c.), is administered hypodermically and repeated every hour in decreased doses until the pulse is perceptibly softened and slowed. At the onset of the convulsions, **morphine sulphate**, $\frac{1}{3}$ grain (0.02 Gm.), is administered hypodermically and repeated in an hour if the convulsions continue. **Chloroform** inhalation is administered just prior to the convulsions, if they can be anticipated by the restlessness and twitchings of the patient, and discontinued during the stage of stupor. If administered in this manner and with **oxygen**, as it should be, if available, there is practically no danger of any chemical effect upon the liver—an effect to be feared when chloroform is used carelessly.

Krönig obtained favorable results from the employment of **lumbar puncture**, but it is considered of doubtful value by others who have used this procedure.

Renal decapsulation may be employed with advantage as a last resort in cases which show a total suppression of urine following delivery.

Surgical Treatment.—When the symptoms which forbode the development of eclampsia do not yield to the dietetic, hygienic, and medicinal treatment outlined, or the convulsions actually occur, and recur in increased frequency and severity, the time for temporizing has past. With 2 or 3 convulsions, then, increasing in frequency and severity, and the patient not recovering consciousness between them, in spite of treatment, the indications to **evacuation of the uterus** are well established, and surgical intervention is imperative. The nearer to term, the easier the procedure of emptying the uterus; the same statement applies to the multipara as to the primipara. The methods of procedure are briefly as follows: Under strict asepsis and antisepsis, including thorough vaginal irrigation, a **rubber tube** is **passed well into the uterine cavity** between the fetal membranes and decidua, and the vagina tamponed with sterile gauze. Ordinarily dilatation is sufficient if the tube is of moderate size; if insufficient, the **bar dilator** may be used, and the necessary dilation accomplished with a few whiffs of chloroform inhalation. The cervical portion of the uterus is not very sensitive and can be grasped with a double tenaculum during the introduction of the tube, otherwise the tube is liable to curl upon itself and the contractions be unnecessarily delayed. If the blood-pressure is high, it will be advantageous to purposely rupture the membranes; if not, there need be no necessity for rupturing them as the tube passes readily between the chorion and decidua. The rectal tube should be from three-fourths of an inch to an inch longer

than the uterine sound from which it is introduced. The sound is bent to the proper angle and carried just within the cervix, when the tube is slipped from off the sound, while the uterus is being held in the proper position. Labor is then allowed to come on gradually, which may require from four to twelve hours and possibly longer, if the tube is not well placed. If the condition is urgent, the **hydrostatic bag** may be introduced, hastening the dilation process, and **dilation** completed by the **bimanual** method. If the condition is desperate and the symptoms grave, rapid dilation may be effected by the use of the hydrostatic bag, with intermittent traction, followed by rapid manual dilation, under chloroform anesthesia (with oxygen), and delivery with forceps or by version.

If the cervix is rigid and unyielding (characteristic of the primipara, with whom five out of six eclampsias occur), the **Dührssen incisions** may be made, or **vaginal hysterotomy** may be performed. In the absence of disproportion, vaginal hysterotomy offers a very much better opportunity for recovery than the suprapubic Cesarean section. No toxic person is a good subject for this major operation, and I have always limited it to pelvic contraction or disproportion from other causes.

Where surgical intervention is imperative, Williams prefers **vaginal hysterotomy** to abdominal **Cesarean section**, as recommended by Halbertsma, since the former is less dangerous and convalescence is more quickly established. He considers that the latter is only indicated where a contracted pelvis, tumor formations, or conditions exist which would de-

mand its use, aside from the presence of the eclampsia. In postpartum eclampsia, the treatment consists of **elimination**; free purgation with **elaterium** or the **saline cathartics**; **high colonic irrigation** with the **alkaline solution**, or by the **continuous drop method** in the **Fowler position**; **veratrum viride** and the **nitrites**. The indications for the use of **morphine**, the **bromides**, **chloroform**, and **venesection**, as previously described, here apply, except that venesection may be more frequently indicated in the sthenic, while hypodermoclysis or the intravenous injection of the **saline solution** will be more frequently indicated in the asthenic type of individual. The after-treatment consists of **liquid diet**, largely **alkalinized milk**, and keeping active the secretions and excretions. No stimulating diuretics should be administered until readjustment of the kidneys takes place. Later on, **Basham's mixture**, reinforced with 5 minims (0.3 c.c.) of tincture of **chloride of iron**, especially if the patient is anemic, is useful.

Neither interruption of pregnancy nor, ordinarily, any effort to hasten labor is countenanced by the writer, who favors **venesection**, 1000 c.c., unless the blood-pressure falls to 100 or the pulse rapidly changes, when the venesection is stopped. The results are so striking that other eliminatory measures are dispensed with, except for **colonic irrigations** once daily. **Morphine**, $\frac{1}{2}$ grain (0.03 Gm.), is given at once on admission and is repeated in $\frac{1}{2}$ this dose hourly until the convulsions cease or the respirations are markedly lowered. To avoid disturbance, the venesection, hypodermics, etc., are carried out during the coma following a convulsion. A. C. Beck (Amer. Jour. Obst. and Gyn., June, 1924).

Case in which the convulsions did not begin until the 8th day after nor-

mal labor, appearing abruptly and with fever. **Curettage of the uterus**, with evacuation of adherent, fetid portions of placenta, after 45 convulsions had occurred, was followed by gradual recovery. J. A. Beruti and M. Isaac (Sem. méd., Jan. 29, 1925).

Magnesium sulphate intravenously in 10 per cent. solution employed in 17 cases, with but 1 maternal death. Other eliminative measures, such as **venesection, gastric lavage, colonic flushings with glucose and soda**, and the administration of **castor oil**, were carried out as in the treatment of any toxemic condition. All of the patients in the series thus treated belonged to the profoundly toxemic variety of case. Lazard (Amer. Jour. of Obst. and Gyn., Feb., 1925).

J. C. APPLEGATE,
Philadelphia.

PUERPERAL SEPSIS. See WOUNDS, SEPTIC, AND SEPSIS.

PURPURA.—Purpura (hemorrhæa petechialis, Blutfleckenkrankheit) is a hemorrhagic cutaneous affection characterized by the appearance on the skin of hemorrhagic patches or macules, of various sizes and shapes, reddish purple in color, and not disappearing under pressure.

It is so often associated with other diseases that strictly speaking it should rather be regarded as a symptom. In the infectious eruptive diseases (scarlet fever, measles, and smallpox) its appearance, although comparatively rare, is usually an indication of malignancy. It is a regular feature of the eruptions in typhus fever and cerebrospinal meningitis. It may occur in malaria, diphtheria, and septic disorders. Finally, it is also observed unassociated with serious infectious disease.

Three varieties of purpura are usually recognized, differing in premonitory and constitutional symptoms, in the extent of the hemorrhagic extravasations, and in their causation: purpura simplex, purpura rheumatica, and purpura hemorrhagica.

SYMPTOMS.—Purpura simplex usually appears suddenly overnight, but sometimes gradually in the course of several days. The eruption consists of bright- or deep-

red or purplish spots, variously shaped, and in size from a pin's point to that of a pea. They are circumscribed, not elevated, are situated deep in the skin, do not disappear on pressure, are symmetrically distributed, and are chiefly found on the lower extremities, especially the thighs. Subjective symptoms are usually absent, except a general soreness of the skin. Occasionally there may be moderate itching, slight lassitude, and malaise, rarely pain. When wheals develop as a complication, the itching may be severe and the condition is called *purpura urticans*. In one or two weeks the disease has usually run its course, but it may be prolonged for months by the appearance of successive crops of the eruption. It occurs generally in debilitated and, especially, old persons.

Purpura rheumatica (peliosis rheumatica; Schönlein's disease) is preceded or accompanied by lassitude, despondency, anorexia, constipation, fever, and rheumatoid pains, particularly in the lower extremities, about the joints. One or more joints may be swollen. After several days or a week the eruption appears, principally on the abdomen and limbs. The spots are circumscribed, somewhat raised or on a level with the skin, split-pea to finger-nail in size; at first pink, reddish, or purple, they later assume the color changes common to an ecchymosis, changing into yellowish and greenish tints, and then disappearing entirely. Rarely a hemorrhagic spot becomes gangrenous. The rheumatoid pains may either abate or disappear with the appearance of the eruption; in many cases the constitutional symptoms continue throughout the disease or appear as relapses, with successive crops of the eruption. The disease is uncertain as to course and duration. Hemorrhage from the internal organs, most often the kidneys, may occur as a complication and may prove fatal. Gastrointestinal disturbances (colic, vomiting, diarrhea) may appear as complications, and less frequently hemorrhage from the stomach or bowels, which may induce local necrosis, perforation, and peritonitis.

This form of purpura is rare and is somewhat related to erythema multiforme, with which it may be associated. It is

occasionally met with in children and young adults, and usually occurs in persons having a rheumatic history or heredity.

Purpura hemorrhagica (*Werlhof's disease*; *morbus maculosus Werlhofii*) is a severe form of the disease. The onset is preceded or accompanied by marked constitutional symptoms of systemic depression and fever. Hemorrhagic spots suddenly appear, varying in size from a small coin to the palm of the hand, usually first on the limbs, and then on other parts of the body. They may be noticed on the hard palate, the inside of the cheeks, and other parts of the mouth. In exceptional cases there is an extravasation beneath the epidermis, giving rise to a blood-blister. Coincident with or shortly after the appearance of the eruption, hemorrhages may occur from the mucous membranes, especially the mouth, gums, nose, fauces, bowels, and kidneys. Hemoptysis, effusions beneath the conjunctiva, into the retina, choroid, and sclerotic, and metrorrhagia have been reported. Meningeal or cerebral hemorrhage may give rise to epileptiform seizures and paralysis.

The course and duration of the disease are uncertain. It may terminate suddenly in a week or two, or may continue longer. It is a dangerous disorder, and death not infrequently occurs. Debility, neurasthenia, and deficient nutrition predispose to this condition, but it may occur in the apparently robust. Relapses are common.

In 1915 E. Frank introduced the term *essential thrombopenia* as a more accurately descriptive substitute for "purpura hemorrhagica," and enumerated the salient features of the condition thus: Hemorrhagic diathesis, non-hereditary; diminution or absence of platelets; prolonged periods of hemorrhage; diminished blood coagulability, and diminished retractility of blood clots. In 1920 Eppinger suggested, as a further improvement, since widely adopted, *essential thrombocytopenia*, implying the reduction in blood platelets. The features of thrombocytopenic purpura have been enumerated by W. J. Mayo thus: Chronic hemorrhagic purpura; deficiency of platelets; greatly prolonged bleeding time; non-retractile clots, and usually enlargement of the spleen. When the blood platelets are constantly below 20,000 per cu. mm. (normal

200,000 to 400,000), purpuric manifestations are likely to occur, and if below 10,000, purpura is pronounced.

Under the name of **Henoch's purpura**, a number of cases occurring in children have been described, the chief features of which are: An eruption of purpuric spots, variously distributed, with or without articular pain and swelling, colic with tenderness over some part of the colon; occasionally vomiting; generally more or less hemorrhage from the bowel, and sometimes hematuria and acute nephritis. The lesions may somewhat resemble those of erythema multiforme, and at times there is edematous swelling suggesting angioneurotic edema. As a rule there is but little fever, but there is a tendency to relapse, the purpuric spots and intestinal hemorrhage recurring, so that the disease may be weeks or months in duration, followed by convalescence; when severe nephritis complicates, however, it may prove fatal, death coming on rapidly with profound toxic or septic symptoms (*purpura fulminans*).

DIAGNOSIS.—The characteristic lesions, uninfluenced by pressure, usually render the diagnosis clear. Purpura hemorrhagica, however, may be confounded with *scorbutus* (*scurvy*), but the former has no etiological relationship to lack of vitamins, has slight or no prodromes, a sudden onset, less marked muscular pains, absence of brawny infiltration of the lower extremities, and hemorrhages from the mucous membranes so severe as to be often fatal. The gums often bleed in both diseases, but in purpura they are not swollen.

Chronic purpura may be confounded with *hemophilia*; purpura, however, is neither congenital nor hereditary. In *hemophilia* there is a lengthening of the coagulation time of the blood, but the clot, when formed, contracts; in purpura, the coagulation time is normal, but the clot does not contract. In *hemophilia* the blood-platelets remain about normal in number, while in purpura there is a marked diminution, sometimes almost to the point of absence.

During a remission, the diagnosis of purpura may often be established by applying a tourniquet about the arm for three minutes long enough to check the venous flow, when petechiae will generally form (capillary resistance test).



Purpura Hemorrhagica.
Saint-Louis Hospital, Paris.

ETIOLOGY AND PATHOLOGY.

Purpura is generally considered to be due to the action of some poison on the blood and possibly also on the walls of capillaries. It is common in the various infectious diseases and may be caused by drugs (benzol, iodides, bromides, arsenic, chloral, copaiba, quinine, salicylates, etc.) in susceptible subjects, and by toxics resulting from faulty metabolism. Renal disease or insufficiency is not infrequently present. Purpura has been observed to follow an infection of diphtheria antitoxin. Purpura hemorrhagica of a severe type may occur during menstruation and pregnancy and not infrequently lead to death; occurring during pregnancy, it leads to abortion or premature delivery. Purpura sometimes appears during or subsequent to typhoid fever or acute rheumatism, and may closely follow acute tonsillitis. It may occur in the later stages of hepatic cirrhosis, bone-marrow tumors, pernicious anemia, aplastic anemia, and leukemia. When acute, the two last-named conditions frequently exhibit an acute purpura, with early death.

In Henoch's purpura the pathological findings range from simple hemorrhage and edema to intussusception, gangrene, perforation, and peritonitis.

PROGNOSIS.—The prognosis in purpura simplex and purpura rheumatica is favorable; in a few weeks or months recovery may be expected. In purpura hemorrhagica, however, the prognosis depends largely on the cause; prognosis should be guarded, as death not infrequently occurs from internal hemorrhage, anemia, heart-failure with pulmonary edema, or from cerebral hemorrhage.

TREATMENT.—The treatment is mainly that of the underlying disorder, where a cause can be found. Patients who have a rheumatic history and symptoms will be benefited by the salicylates, alkalies, and other antirheumatic remedies. Attention to diet and hygiene is necessary. Rest is of great value, and if the hemorrhage is extensive it is obligatory that the patient assume and keep the recumbent posture. Turpentine and the mineral acids, e.g., aromatic sulphuric acid, 15 to 30 minims (1 to 2 c.c.) 3 times a day, have been thought beneficial in all forms of the disease. Schamberg found turpentine in 5-minim (0.3 c.c.) doses, given in emulsion with

tragacanth and flavored with lemon-syrup, particularly serviceable. Quinine, tincture of ferric chloride, ergot, and arsenic have also been lauded. In chronic syphilitic purpura potassium iodide gives good results.

Calcium chloride or lactate in doses of 5 to 30 grains (0.3 to 2 Gm.) three times a day has been favored by several observers, but on doubtful scientific grounds. With the calcium Russell uses a diet of raw meat and fresh milk. Gelatin and orange juice may be freely given by mouth (Bodenheimer).

Horse serum, rabbit serum, antidiphtheritic serum, and autoserum, 4 to 20 c.c., have all been useful, but the most effective measure is generally acknowledged to be blood transfusion. Frequently repeated moderate amounts of blood are preferred to single large transfusions. M. Dixon had gratifying results from injection of human blood in 2 to 5 c.c. amounts.

Gram, in a case of purpura hemorrhagica of 4 months' standing, had success with intragluteal milk injections,—8, 2, 4, and 4 c.c. in the course of 2 months,—together with a colon bacillus vaccine for urinary tract infection.

Splenectomy has been performed in numerous cases, the typical results being an enormous (but in part temporary) increase in platelets, cessation of the hemorrhagic tendency, and apparent cure of the disease. The operation seldom succeeds, however, in acute purpura. Stephen and Pancoast have reported some benefit from X-ray irradiation of the spleen. Lemaire and Debaisieux, in a case too anemic for splenectomy, had success with ligation of the splenic artery.

Foci of infection should be sought and removed in the chronic cases.

Locally, astringent lotions and ice may, in suitable cases, be used. Compression with a roller bandage is advised by Besnier.

S.

PYRAMIDON (AMIDOPYRIN).—Pyramidon, or dimethylaminoantipyrin [$C_3ON_3(CH_3)_4C_6H_5$], is a substitution compound of antipyrin. It occurs in colorless or white crystals, without taste. One Gm. is soluble in 18 c.c. of water and in 1.5 c.c. of alcohol. It is official as *Amidopyrin*. The dosage ranges from 3 to 8 grains (0.2 to 0.5 Gm.).

Pyramidon monacamphorate (neutral), pyramidon bicamphorate (acid), and pyr-

amidon salicylate, unofficial, occur as white crystalline powders, rather freely soluble in water and in alcohol. They are given in doses of 5 to 12 grains (0.3 to 0.75 Gm.).

PHYSIOLOGICAL ACTION.—According to Filehne, the action of pyramidon on the nervous system is similar in all respects to that of antipyrin. The mechanism of its antipyretic action is the same; it lowers the body temperature by increasing the dissipation of heat. There are, however, minor differences of effect: pyramidon is required in doses only a third as large, and its antipyretic action is more gradual and lasts longer.

A. Robin and G. Bardet have found that pyramidon in small doses exerts a stronger analgesic influence than antipyrin, and is not followed by the untoward effects incident to the use of the latter. While antipyrin diminishes the quantity of urea excreted by checking metabolic changes, pyramidon, on the other hand, tends to augment it in consequence of the increased metabolism which it excites. In fevers they have found that the co-efficient of oxygenation is increased by the use of pyramidon; the quantity of urea is not lessened, but may be increased. In diabetes both the urea and sugar are increased,—the opposite of the effect of antipyrin.

W. Pauli reports 2 instances in which the use of pyramidon was followed by untoward effects. In 1 case, after 5-grain (0.3 Gm.) doses there was painful paresthesia of both forearms, which radiated into the fingers and increased in severity on the following day. In 3 similar cases in which this dosage was given sleeplessness resulted, which disappeared on cessation of the remedy, but returned when the same dose was repeated. The second patient showed an eruption which resembled urticaria, over the face, neck, arms, joints, and chest. Upon the face these spots became confluent and later resembled the eruption of measles. Robin and Bardet observe that, as the dose of pyramidon is smaller than that of antipyrin, it is less likely to cause cutaneous eruptions. No injurious effects have been noticed upon gastric function, the circulation, or upon the heart, even when the action of the latter was weak.

THERAPEUTIC USES.—The value of pyramidon rests mainly upon its antipyretic and analgesic properties. In the treatment of **typhoid fever**, M. John considers pyramidon at least as useful as hydrotherapy, he having tried it in 38 severe cases. In 1 case where the administration of several baths a day for a week had failed to remove either the stupor or the serious weakness of the circulation, pyramidon given in doses of $2\frac{1}{2}$ grains (0.15 Gm.) every three hours for two consecutive days cleared the patient's mind, reduced the fever and caused definite manifestations of general improvement. The same effects were obtained in 9 other delirious and totally unconscious patients, usually after two or three days of treatment. The drug failed in only 1 case, in which exceedingly numerous ulcerations were found throughout the ileum and cecum; 3 other patients died, 1 from cardiac failure, 1 from perforative peritonitis, and 1 from intestinal hemorrhage. Small doses are usually prescribed, $1\frac{1}{2}$ grains (0.1 Gm.) every two hours, or $2\frac{1}{2}$ grains (0.15 Gm.) every three hours until the temperature and general condition are not markedly altered on tentatively discontinuing the medication for one or two days.

Hirtz observed sudden decline of temperature in several **typhoid** patients after doses of $2\frac{1}{2}$ to 3 grains (0.15 to 0.2 Gm.) of pyramidon in combination with caffeine, and 1 patient suffered with severe vomiting, so that intestinal perforation might have been suspected. During the febrile period, therefore, he favors doses not exceeding $\frac{3}{4}$ grain (0.05 Gm.) of pyramidon combined with caffeine.

Feuerstein used pyramidon as an antipyretic in 42 cases of **phthisis**, in all stages of consolidation, using single doses of $3\frac{1}{2}$, 5, and 10 grains (0.2, 0.3, and 0.6 Gm.). In all cases the temperature declined gradually, reaching its lowest point in about two hours, where it remained for from four to six hours, and then gradually rose. Complete defervescence could be obtained from 10 grains (0.6 Gm.) given in doses of $3\frac{1}{2}$ grains (0.2 Gm.) hourly. The longest duration of low temperature was six and the shortest two hours.

Lyonnet tested pyramidon bicamphorate (acid) upon 15 cases of tuberculosis, who

were suffering from severe **night-sweats** and **high fever**, giving $7\frac{1}{2}$ grains (0.5 Gm.) twice daily in form of powder. The remedy was well tolerated and marked general improvement and diminution of the sweats followed.

F. Tauszk has also demonstrated the antipyretic and antihydrotic effects of the camphorates of pyramidon, the antipyretic effect being greater in the neutral (or mono) camphorate, and the antihydrotic action prevailing in the acid, or bicamphorate. The salicylate, he finds, is especially indicated in tuberculosis complicated with pleurisy.

Rahn has employed the monacamphorate (neutral) and bicamphorate (acid) in various **febrile pulmonary affections** and in **inflammations of serous membranes**. He alternates the camphorates, giving daily doses of from 6 to 12 grains of the neutral camphorate, and from 10 to 15 grains (0.6 to 1 Gm.) of the acid camphorate. He also found the camphorates valuable in **acute, subacute, and chronic inflammation of the lungs**, of **tuberculous and catarrhal character**; in **febrile bronchitis, fibrinous and purulent**; in **dry and exudative pleurisy**; and in **influenza complicated by pneumonia or pleurisy**.

Filehne proved the efficacy of pyramidon as an antipyretic in **typhus and scarlet fevers, influenzal pneumonia, and pseudo-leukemia**.

The analgesic effects of pyramidon have been studied by Filehne, who found that it promptly relieved pain of various kinds, such as **febrile headache**, pain in the lymph-glands and the spleen in **pseudo-leukemia**, that of **tuberculous peritonitis, anemia, and multiple neuritis and intercostal neuralgia** occurring as a sequel of **influenza**. In **headaches**, 6 grains (0.4 Gm.) are sufficient.

In **rheumatic affections**, especially in **acute and chronic rheumatism, gout, neuralgia, and in dry and exudative pleurisy** pyramidon salicylate is indicated. Rahn confirms the observations of Landenheimer as to the efficacy of pyramidon salicylate in the **headache of alcoholics**.

Karl Martin found pyramidon salicylate beneficial in **herpes zoster**, giving prompt relief to the severe pain.

Vogt advises pyramidon in the **lightning**

pains of locomotor ataxia, in a single dose of $7\frac{1}{2}$ grains (0.5 Gm.) followed by one or two cups of hot milk or tea; the pain diminishes in twenty minutes and often entirely disappears in a half-hour. Landenheimer confirms this, but finds that the benefit is only temporary. He has not observed any beneficial action following the use of pyramidon in chronic rheumatism.

In diabetes pyramidon is contraindicated, as it increases the output of sugar.
W.

PYROGALLOL.—Pyrogallol, U. S. P., or pyrogallic acid, is a triatomic phenol, obtained chiefly by the dry distillation of gallic acid. It occurs in white, lustrous, odorless scales or needles, having a bitter taste and soluble in 2 parts of water, 1 of alcohol, and 2 of ether. It is a strong reducing agent, to which property it largely owes its therapeutic effects. It darkens on exposure to light. Its watery solutions, or even the moistened crystals, in contact with the air, absorb oxygen and acquire a brown color; the reaction of the fluid also changes from neutral to acid. The color change takes place more rapidly if a caustic alkali is present in the solution. It is not administered internally. It is used externally in ointment and in powder (5 to 10 per cent.). The stronger ointments have a caustic effect. Pyrogallol possesses antiseptic properties.

POISONING BY PYROGALLOL.—The incautious application of pyrogallol may cause inflammation of the skin up to the point of ulceration and sloughing. Fatal intoxication has followed the inunction of one-half the body with a 10 per cent. ointment, the surface being afterward covered by gutta-percha tissue and a bandage (Neisser). The symptoms began within two hours, with rigors, diarrhea, vomiting, and strangury. The next day the urine was very dark colored (hemoglobinuria); all the symptoms became aggravated, with apathy, dyspnea, exaggerated reflexes, and collapse, followed by death two days later.

A severe case of poisoning from pyrogallic acid is reported, in which it was employed in ointment form for psoriasis.

Treatment of Poisoning by Pyrogallol.—On the first appearance of gastrointestinal disturbance, strangury, or smoky urine, the remedy should be at once discontinued. Neisser suggests, further, the subcutaneous injections of ether, alcoholics frequently repeated, energetic stimulation of the surfaces and the inhalation of oxygen. The mineral acids act as antidotes.

THERAPEUTICS.—Pyrogallol was introduced in 1878 by Jarisch as a remedy in psoriasis and lupus. It has since been shown to be of value in parasitic skin diseases, as eczema marginatum, in epithelioma, in simple chancre, and in phagedena. Unfortunately, it stains the skin, hair and nails, as well as linen apparel with which it comes in contact.

In psoriasis a 10 to 15 per cent. ointment is thoroughly rubbed into the affected areas. In lupus pyrogallol acts upon the diseased tissues as a mild escharotic. The rapidity of its action is increased when the epidermis is intact by first applying a moderately strong solution of caustic potash. A 10 to 20 per cent. ointment is applied on lint, and covered with a piece of gutta-percha tis-

sue, which may be made to adhere to the skin by moistening its edges with chloroform. The applications are renewed daily for two to seven days, until the lupus patch has been converted into a gray, pultaceous mass. Iodoform ointment or a mercurial plaster is then applied. This treatment is applied at intervals so long as any lupus tubercles are visible.

In lupus Resnier has used a saturated solution of pyrogallol in ether, which he brushes over the lupus patch and covers with traumaticin. Brocq prefers a solution of pyrogallol with salicylic acid (10 per cent. of each) in collodion.

In tuberculosis of the skin the affected tissues may be destroyed with an ointment composed of petrolatum containing 10 per cent. of pyrogallol; this is spread on lint and applied to the part for three to five days. The wound so produced is then allowed to heal, being dressed with a petrolatum ointment containing from $\frac{1}{2}$ to 2 per cent. of pyrogallol.

Epithelioma is treated in the same way as lupus. In simple chancre Vidal used a 25 per cent. ointment and for phagedena a powder of pyrogallol and starch (1 to 4). S.

Q

QUARTAN FEVER. See MALARIAL FEVERS.

QUASSIA.—Quassia, U. S. P., is the wood of *Picrasma excelsa*, or of *Quassia amara* (family, Simarubaceæ): a large tree indigenous to Jamaica and other parts of the West Indies. It occurs usually in the form of small chips or rasplings, nearly white in color, odorless, but very bitter. The wood is sometimes turned into cups, which are used by pouring hot water into them, and allowing it to remain for several hours; the water becomes quite bitter, having absorbed the bitter principle from the wooden cup. Quassia contains a bitter, neutral principle, quassin (quassiin), which occurs in white, opaque, intensely bitter crystals; is soluble in alcohol, hot water, and chloroform, and slightly soluble in cold

water. It also contains a minute quantity of a volatile oil, but no tannin.

PREPARATIONS AND DOSES.—

Quassia, U. S. P. (the wood or crude drug; bitter-wood). Dose, 5 to 10 grains (0.3 to 0.6 Gm.).

Tinctura quassiae, N. F. (tincture of quassia, 20 per cent). Dose, 15 to 60 minims (1 to 4 c.c.).

Fluidextractum quassiae, N. F. (fluidextract of quassia). Dose, 5 to 15 minims (0.3 to 1 c.c.).

Extractum quassiae, N. F. IV (solid aqueous extract of quassia). Dose, 1 to 3 grains (0.06 to 0.2 Gm.).

The B. P. recognizes *Quassiae lignum* (wood of *Picrasma excelsa*), a 10 per cent. tincture, and a 1 per cent. infusion.

POISONING BY QUASSIA.—Taken in overdose, quassia acts as an irritant of the mucous membrane of the stomach and

as a nauseant. Potter reports serious symptoms of narcotism from quassia in a child of 4 years. In dose of about $\frac{1}{4}$ grain (0.015 Gm.). Campardon found quassia to produce severe headache, severe burning pain in the throat and esophagus, nausea, vertigo, restlessness, diarrhea, and frequent passage, but diminished secretion of urine. F. Venn, of Chicago, reported a fatal case of poisoning from a decoction of 2 ounces (60 c.c.) of quassia injected into the rectum of a child for the treatment of seat-worms.

THERAPEUTICS.—Quassia is a simple bitter without astringency, and has been found useful in **convalescence from acute fevers** to increase the appetite and improve the digestion. In **atony of the stomach, or simple dyspepsia** with eructations after meals, the administration of quassia is followed by good results. It is used in **diarrhea from indigestion** and as a stomachic in **malarial affections**. An infusion of quassia—1 to 2 ounces (30 to 60 Gm.) to the pint (500 c.c.) of boiling water—is a reliable remedy, given as an enema, to destroy thread-worms (*ascarides*) in children. Before giving the enema—from $\frac{1}{2}$ ounce to 1 pint (15 to 500 c.c.)—the bowel should be well washed out by injections of soap and water. The enema should be retained for some minutes. S.

QUEBRACHO.—Quebracho, or *aspidosperma*, is the bark of the *Aspidosperma quebracho-blanco* (family, Apocynaceæ): a large tree indigenous to Brazil and Catamarca (Argentine Republic). It contains 6 alkaloids: Aspidospermine, aspidospermatine, aspidosamine, quebrachine, hypoquebrachine, and quebrachamine. Quebrachine has been used the most.

PREPARATIONS AND DOSES.—*Aspidosperma*, U. S. P. IX (*aspidosperma*; *quebracho*). Dose, 1 dram (4 Gm.).

Fluidextractum aspidospermatis, U. S. P. IX (fluidextract of *aspidosperma* or *quebracho*). Made by extraction with a mix-

ture of glycerin, 11; alcohol, 67, and water, 22. Dose, 1 fluidram (4 c.c.).

The sulphates of aspidospermine and quebrachine have been used internally and by hypodermic in doses of from 1 to 2 grains (0.06 to 0.12 Gm.).

POISONING BY QUEBRACHO AND PHYSIOLOGICAL ACTION.—In toxic doses quebracho causes salivation, paralysis of respiration, and diminished action of the heart and convulsions; death is caused by paralysis of the respiratory center. After prolonged medicinal use, quebracho appears to cause a disturbance of the sympathetic nervous system. The blood of animals poisoned by quebracho becomes red. Bardet found that it distinctly increases the depth of the respiratory movements, retards the pulse (contrary to Penzoldt's view), and causes a fall in the temperature.

Quebrachine, according to Douglas Cow, is by far the most toxic of the 4 alkaloids investigated. In small doses it stimulates the central nervous system, causing deeper and quicker respirations. In large doses it has a paralyzing effect on the nerve-cells of the autonomic system, brain, and cord. In still larger doses it paralyzes the vagus, the sympathetic, and the motor nerve-endings belonging to the curare-nicotine-conine group of drugs. It causes death by paralyzing the respiratory center at a time when the motor nerves are still responsive to electrical stimulation.

THERAPEUTICS.—Quebracho is sometimes employed in the various forms of **dyspnea**, on account of its stimulant action on the respiratory system. It has also been employed in the treatment of asthmatic conditions, being claimed useful as a palliative in **bronchial asthma**. S.

QUINIDINE. See CINCHONA and HEART, DISEASES OF.

QUININE. See CINCHONA.

R

RABIES (*Hydrophobia*; *Lyssa*; *Madness*).—**DEFINITION.**—Rabies is an acute infectious disease of animals occasionally communicated to man, characterized by excitement, hyperesthesia, deglutitionary spasm, and paralytic weakness, caused by a specific but unknown virus, and which unless forestalled by specific prophylaxis ends in death.

INCUBATION.—This varies widely in different cases. It is shorter in children than in adults, and in wounds about the face, head, and hands, or uncovered parts, than in the case of injuries received in other parts of the body through the clothing. The severity and character of the wound also influence the time of onset, the symptoms appearing sooner in cases of infection from punctured and lacerated wounds.

The incubationary period generally ranges between three and ten weeks, but it may be, in occasional instances, six months or even a year or more. The wound through which infection takes place has usually healed entirely before any symptom of rabies is apparent, but in some cases, when the disease appears, the wound becomes irritated and again inflamed. Of persons bitten by rabid dogs, only a small proportion—10 to 20 per cent.—become infected.

Case of typical hydrophobia developing 18 months after the bite of a rabid dog. The region of the bite became painful at the time the disease developed. P. J. Freyer (*Brit. Med. Jour.*, June 28, 1919).

SYMPTOMS.—The early symptoms in man are: General nervousness, with irritability, wakefulness, and depression of spirits. There is

often headache and vague uneasiness, sometimes slight fever and rapid pulse. The wound may become painful and the surrounding tissue show anesthesia even before any other symptoms appear. Wesson has called attention to an early tendency to paralysis of the left leg, or the left hind limb in animals. Some slight stiffness about the muscles of the throat is now noted, the voice changes or becomes husky, and swallowing becomes difficult.

After a short time great restlessness and excitement supervene, together with general hyperesthesia and abnormal reaction to external impressions of all kinds, to the extent, as soon as the height of the attack is reached, of causing reflex spasms. These spasms are quite distressing and severe, involve particularly the muscles of the larynx, pharynx, and mouth, and are accompanied by a sense of intense dyspnea.

The first symptom is a rise of temperature; the next, insomnia, followed in about 3 days by the so-called pharyngeal spasm, which is actually a spasm of the diaphragm, and is best compared to the long, shuddering inspiratory clonic spasm which occurs when a child is immersed in cold water. Before this, however, there is a curious and characteristic mental state of terror. Death occurs usually 48 hours after the appearance of spasm, due to generalized neuritis and central paralysis. In children the symptoms are sometimes atypical, no spasm developing and the patient being able to drink in comfort to the end. R. V. Dolbey and A. El Katib (*Lancet*, Mar. 15, 1924).

Attempts at swallowing or taking water precipitate the violent and painful spasmodic attacks, which fact causes the patient to dread even the

sight of water; whence the common name of the disease: "hydrophobia."

There is often at this stage some mental disturbance, greatest at time of the deglutitionary and respiratory spasms, subsiding in the interval. In other cases delusions and hallucinations, with maniacal excitement, may continue throughout the attack. In some cases there are more general convulsive seizures, resembling, somewhat, those of tetanus. The disease may run its course without rise of temperature, but most cases show some febrile reaction, 100° to 102° being usual. There is oftentimes a copious secretion of saliva, which, owing to the difficulty in swallowing, is allowed to run from the mouth.

The acute spasmodic stage lasts for a day or two, and is then succeeded by a paralytic stage, in which the patient lies quiet, nearly helpless, confused, and finally unconscious. The heart-action becomes progressively more feeble, the respiration shallow and increased in frequency, and death ensues.

In man the initial stage of excitement is rarely absent. But in animals its absence is the usual rule, the stage of paralysis quickly supervening upon the first symptoms of the disease.

Pseudorabies, or Lyssophobia.—

Mention should here be made of this condition, *i.e.*, the morbid fear of hydrophobia, leading, by the influence of autosuggestion, to a group of nervous and hysterical manifestations closely simulating true rabies. A neurotic person of inherited nervous instability and easily influenced by suggestion is bitten by a dog supposed to be mad; after a variable time and often in direct consequence

of having been joked about the danger, or from brooding over the possibility of an attack of the disease, some nervous symptoms paralleling those of rabies appear. The subject becomes apprehensive, despondent, restless, then excited, and exhibits some spasm or a choking sensation in the throat, this being often only a perversion of the frequently seen *globus hystericus*. Occasionally convulsive attacks of an hysteroid character occur. The patient exaggerates the danger and protests that he is really going mad. Other varied hysterical phenomena may be present. The attack does not progress, however: there is no disturbance of general health nor of any of the bodily functions, no temperature changes, no weakness, no prostration. The attack lasts for days or weeks and then subsides. Probably no case has ever proved fatal, the alleged fatal cases being instances of true rabies, as, on the other hand, many of the cases of reported recovery from rabies are most likely instances of the pseudo-affection.

DIAGNOSIS.—While there should be no difficulty in distinguishing between rabies and other affections of the nervous system in which spasms and cramp occur, it is sometimes confounded with tetanus, hysteria, and acute mania.

In *tetanus* there is the typical trismus and an absence of any dread of water and of spasms during intervals. There is no risus sardonicus, anxiety, or restless irritability. The character of the wound in tetanus is also different and the incubationary period much shorter.

Hysteria sometimes gives rise to a condition which resembles rabies,

especially when the patient has been bitten by a dog; there is marked anxiety and convulsions, and sometimes even barking and attempts to bite. The absence of respiratory symptoms, of the risus sardonicus, the absence of spasm during the hysterical convulsions and the history of the case will reveal the true identity of the disorder present.

Mania is distinguished from rabies mainly by its history, the absence of characteristic convulsions and respiratory phenomena, and also the absence of rapid aggravation of all the symptoms.

Pseudorabies.—The greatest difficulty lies in distinguishing true rabies from the pseudorabies. Here a careful consideration of all symptoms and a complete and searching test of the nerve-reactions may be needed to prevent error. The evident influence of suggestion, the discovery of hysterical tendencies and stigmata, and the absence of any real prostration and of any progress in the morbid process exclude pseudohydrophobia.

The diagnosis of rabies may be established by noting certain changes in the nervous system pointed out by Van Gehuchten and Nélis in 1900, and especially noticeable in the Gasserian ganglion and the plexiform ganglion of the pneumogastric. Invasion and destruction of the nerve cells of the ganglia by new-formed cells take place, due to proliferation of the cells of the endothelial capsule. These changes occur if the animal is allowed to die of the disease, and not killed prematurely, as often happens. Chromatolysis affects all the nerve-cells of the cord, and is followed by retraction of the cells from the capsules

and the proliferation of the cells of the latter, already referred to. The chromatolytic changes may be demonstrated by Nissl's stain, and the capsular changes by hematoxylin-eosin.

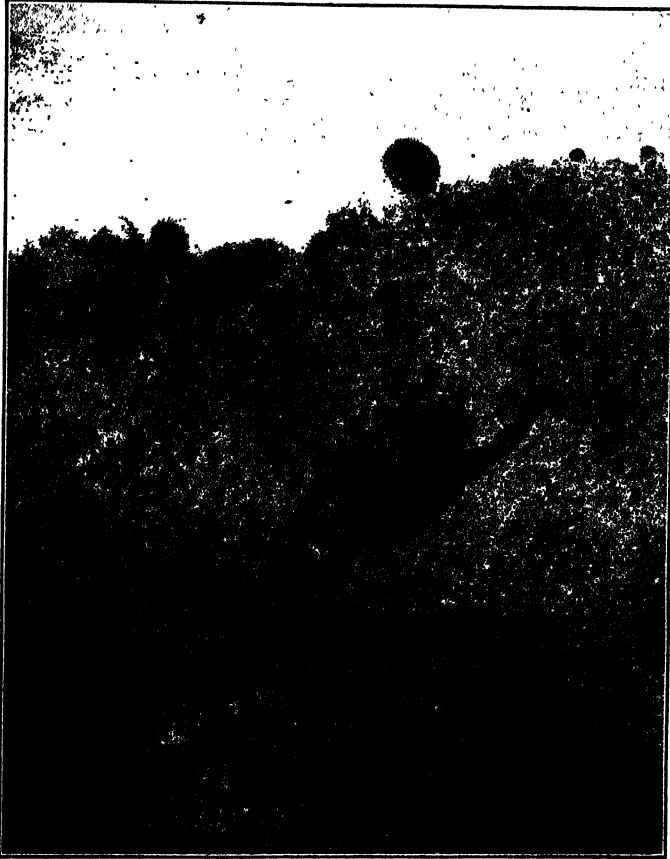
The plexiform ganglion of the pneumogastric is the structure generally investigated in dogs. It is found by identifying the pneumogastric nerve in the neck, tracing it up close to the base of the skull, and seeking for the fusiform, whitish ganglion on the larger of the two trunks into which the nerve divides. As described by Ravenel and McCarthy, the excised ganglion is placed in absolute alcohol for 12 hours, during which the alcohol is changed once. In successive periods of 1 hour each it is then placed in a mixture of absolute alcohol and chloroform, in pure chloroform, in chloroform and paraffin, and finally in pure paraffin. After heating in the oven for a few minutes, the sections prepared are passed through xylol, absolute alcohol, and 90 per cent. alcohol. Next they are stained for 5 minutes in Nissl's methylene-blue formula, differentiated in 90 per cent. alcohol, dehydrated in absolute alcohol, and cleared in oil of cajuput and xylol. The significant capsular changes are demonstrated by staining in hematoxylin-eosin. Ravenel also favors as a stain Grubler's hemalum, with 0.5 per cent. phenol; eosin is used as counterstain. Where the changes in the ganglia are absent in an animal succumbing to disease, according to this observer, rabies is excluded. Their absence in a prematurely killed animal, however, does not reliably possess this significance.

In 1903 Negri observed special bodies or structures (*Negri bodies*) in the cells of the central nervous system of animals affected with rabies. These bodies are believed closely related to the virus of the disease, and are taken to be positively diagnostic. Cases failing to show them have been very rare. Diagnosis by demonstration of the Negri bodies is, furthermore, superior to that by the method of Van Gehuchten and Nélis in that

the Negri bodies generally appear early, are more readily investigated, and can still be found after the specimen has undergone putrefactive changes.

Williams's method for the demonstration of Negri bodies is extensively employed. Smears are made from the hippocampus

nate and to which 0.1 per cent. of picric acid has been added, and stained with one of a variety of stains, Williams favoring a modified Van Gieson's stain consisting of 0.5 part of saturated alcoholic solution of basic fuchsin, 10 parts of saturated alcoholic methylene-blue solution, and 30 parts of distilled water. After covering with this stain, the specimen is heated to steaming,



Negri bodies in the brain. (*Roy and Nichols.*)
(Washington Med. Annals.)

major, the cerebral cortex bordering the crucial sulcus, and the cerebellar cortex, as the Negri bodies are most numerous in the large ganglion cells of these structures. The smears are made by crushing a very small bit of tissue between two slides and drawing the latter apart lengthwise. They are then partly dried in the air, fixed by 10 seconds' exposure to methyl alcohol neutralized with 0.05 per cent. sodium carbo-

washed in tap water, and blotted with filter paper. The Negri bodies, which are intracellular, appear of a magenta color with 1 to 20 or more dots or "inner bodies" stained deep blue or black, while the nerve cells are blue and erythrocytes yellow or salmon color.

In *Lentz's method* of staining, a thin slice of the tissue, spread between slides by slight pressure and longitudinal separation of the

slides, is dried, fixed with methyl alcohol for 10 minutes, and washed in a mixture of alcohol and ether; or, sections of paraffin-embedded tissue may be used. Successive stains of 0.5 per cent. aqueous eosin in 60 per cent. alcohol, Löffler's methylene-blue, and Lugol's solution are applied for 1 minute each, followed by washings in water. The specimen is then treated with methyl alcohol until red; washed; stained with methylene-blue again for $\frac{1}{2}$ minute; washed; blotted; treated with alkaline alcohol until little of the eosin remains; washed in absolute alcohol, and examined. The nerve cells are pale blue; erythrocytes, vermillion; the Negri bodies, crimson, and their "inner bodies," bluish-black.

Inoculation of rabbits with brain emulsion, usually subdurally, is an older method of diagnosis which is now essential only in the few instances in which the examination for Negri bodies fails to give definite information. Since the symptoms of rabies in the inoculated rabbit do not generally appear for 16 to 21 days, this method is not available for demonstrating the need of prophylactic inoculations in persons bitten by supposedly rabid animals.

The time it takes to perform the different tests is about as follows:

Smear test: One hour (frequently less) after arrival of specimen.

Section test: Three to 4 days (a hurried test can be done in a day, but will usually be unsatisfactory).

Animal inoculation test: Ten days to 6 months.

After 30 days the probability of a positive result is small. Judging from 1003 specimens examined, correct diagnosis may be obtainable on the day of receipt of specimen in 90 per cent. of the cases; within 5 days, in about 92 per cent., and at the end of 1 month practically all will be determined. Hasseltine (*Public Health Reports*, xxxiv, 2378, 1919).

While a diagnosis of hydrophobia can be made almost certainly from the clinical symptoms, the only absolute proof is inoculation of filtered human saliva into the brain of a rabbit; in the latter, furthermore, rabies must not be confused with a simple infective meningitis. Dolbey and El Katib (*Lancet*, Mar. 15, 1924).

ETIOLOGY.—Rabies attacks by preference the carnivora and in particular the dog and allied species, although human beings, cats, cattle, horses, and swine are occasionally infected. Birds are also susceptible. It is transmitted from one animal to another by inoculation, usually from a bite, and is comparatively rare in countries and localities in which the muzzling of dogs is made compulsory.

In the dog the first symptoms appear from a few days to weeks after infection. The animal shows a change in disposition, becoming unusually irritable and snappish, although when left alone seeming dull and somnolent. Food is often refused and the animal eats or chews sticks, dirt, leaves, straw, etc. The dog becomes weak, tremulous, and unsteady on its legs in the paralytic form, but in the "furious" form of the disease there is wild excitement, the animal running aimlessly about, barking, growling, and snapping at or biting anything in its way. In either case the creature soon becomes helpless, comatose, and dies. The toxic principle of rabies is widely diffused throughout the bodily tissues, and the disease has been produced by the experimental inoculation of portions of the nervous organs, salivary and mammary glands, suprarenal bodies, and pancreas. The virus is almost surely the product of a specific micro-organism, although bacteriologists have thus far been unsuccessful in attempts to isolate the pathogenic germ.

Occurrence in Man.—Rabies is always communicated to man by inoculation from the bites of animals suffering from the malady.

It is a disease now rarely seen in the Scandinavian countries, Holland, and Switzerland, but is somewhat more frequent in France, Belgium, and Russia, and rather prevalent in Italy and Spain. It was common in Europe some decades ago, but more recently has been markedly less frequent, though a recrudescence took place as a result of the World War. In the United States most of the cases had, until recently, been reported from the Eastern States. Of late there have been outbreaks in various parts of the United States and in Canada.

There were 58 deaths from rabies reported in the Registration Area of the United States in 1919; 41 in 1920; 57 in 1921, and 46 in 1922. From 1909 to 1921 there were 806 deaths. Some 22,000 persons are stated to have applied for the Pasteur treatment in 1923. England suppressed the disease entirely until 1918, when a dog smuggled in reintroduced it; since 1921, however, it has again been absent from England and Wales. Pet animals are for the most part immediately responsible for injuries, though the pariah dog is the vector. That children are so often bitten is partly due to the mistaken idea of adults that a dog, to be rabid, must rush around foaming at the mouth. More cases occur between April and September than in the other months. The disease is constantly prevalent in the rural districts. O. Dowling (Jour. Amer. Med. Assoc., Aug. 15, 1925).

Several instances of the disease that were communicated to man by the bites of skunks have been reported from western States. Coyotes have, however, been the chief agent of propagation in many of those States.

Yount, in 1910, reported on 18 persons bitten by skunks, in Arizona, during a period of two years; 5 of these persons were attacked with rabies, all dying. The skunk is

the most prolific endemic source of the propagation of rabies in Arizona. There is no such thing as a "hydrophobia skunk" *per se*, but all skunks are, like a few other animals, very susceptible to rabies; and no particular species is more susceptible than another. When a skunk, an animal nocturnal in habits, generally timid, attacks man or any other animal, and inflicts a bite, if the skunk is not killed and its bulb examined bacteriologically, it is better to accept this sudden change of disposition on the part of the skunk as *a priori* evidence of rabies, and seek the Pasteur treatment at once.

The cat and wolf may also communicate rabies by their bites, those of the wolf being especially virulent.

PATHOLOGY.—Rabies is, as above indicated, a specific toxemia of unknown microörganismal origin.

The view most generally held is that the Negri bodies are in some way representative of the causal organism, which is thought by some to be a sporozoan. Developmental cycles have, even, been worked out for this parasite, but not definitely demonstrated. According to Babès, the Negri bodies are encapsulated parasites in process of degeneration because of resistance offered by the nerve cells attacked.

The virus is known to be held back by fine filters, in spite of which the filtrate will often cause symptoms somewhat resembling those of rabies, though the disturbance is not reproducible upon further inoculation in other animals. From this it is concluded that the causal agent of rabies produces a toxin acting on the central nervous system, like that of the tetanus bacillus. The virus is attenuated or destroyed by heat, light, and desiccation, but acquires increased power from repeated passages in susceptible animals. It is not destroyed by cold, but yields to a temperature of 60° C. in ½ hour. The best antiseptics against it appear to be, according to Ravelin, 1:1000 mercury bichloride, 6 per cent. citric acid solution, and a saturated aqueous solution of iodine. Bile soon destroys it.

In the infected animal, the saliva contains the virus even a day or two before any of the symptoms of rabies have appeared. Any of the nervous tissues will act as a culture medium for the virus, which slowly

extends from the point of inoculation throughout the nervous system. Nervous tissues thus act as the chief path of its spread, and section of a nervous pathway is found to check propagation of the virus beyond the point cut. Even after the virus has reached the nerve-centers, no symptoms appear for a considerable period.

Some morbid anatomical changes in the nervous system are nearly always found in rabies, these changes being: Dilatation of the capillaries and other small blood-vessels; accumulation of leucocytes in the perivascular lymph spaces; minute extravasations of blood, and some hyaline areas in the vessel walls. These alterations, insofar as the spinal cord is concerned, are particularly pronounced in the anterior and posterior horns and in the vicinity of the central canal.

In addition, there are marked changes in the ganglion cells of the brain-cortex and medulla, especially the latter, in the region of the nuclei of the pneumogastric, hypoglossal, and spinal accessory nerves (Gowers). The ganglion cells show an indistinct outline, a granular and fragmented nucleus, granular and hyaline cytoplasm, or vacuoles or large spaces. Around the affected ganglion cells are seen the same leucocytic accumulations as exist about the vessel walls, giving rise to what have been termed "miliary abscesses" or "rabies tubercles" (Babès). The pathological changes in the spinal cord ganglion cells are usually not well marked.

The pathological changes of asphyxia are often present, predominating in some cases or even being the only lesions found. The mucous membrane of the fauces, larynx, pharynx and stomach is often congested. In man there may be hyperemia of the lungs

and emphysema, and even rupture of chest muscles, caused by the convulsive movements. The salivary glands have been found to show the changes of a mild inflammation, and a mild parenchymatous nephritis is often present. In dogs the stomach may contain straws, sticks, stones, leather and other foreign matter eaten by the animal, but apart from such contents it is shrunken and empty of food.

PROGNOSIS.—The hope of recovery from true rabies is extremely slight, death ensuing after a few days in almost every instance.

During the past few decades excellent results in preventing the development of rabies in persons bitten by rabid animals have been obtained by the use of the preventive inoculations described in a later section of this article.

Among over 45,000 cases treated prophylactically at the Institut Pasteur, Paris, the mortality from rabies was but 0.33 per cent. Even with prophylactic treatment, however, the prognosis varies with the location and size of the injuries, the kind of animal responsible, and the promptness of prophylactic treatment. Danger is greater in bites on uncovered surfaces (clothing wiping off the virus from the teeth) and likewise in tissues abundantly supplied with nerves, such as the face and hands. The risk is thus several times greater in bites of the head than of the lower extremities. Bites by wolves are many times more fatal than by dogs, partly because the former are more likely to lacerate the face. The risk of the development of rabies in persons bitten by an infected dog, without prophylactic treatment, is generally estimated as averaging 15 to 17 per cent. Proper cauterization of the wound considerably reduces the risk of infection, but is in no sense a substitute for the Pasteur treatment. Fatality seems to be somewhat greater in adults than in children.

All of the 1481 subjects inoculated preventively in Paris in 2 recent years

proved to have been successfully protected. Viala (Ann. de l'Inst. Pasteur, July, 1924).

TREATMENT.—As soon as a person is bitten by a supposedly rabid animal, a **ligature** should be placed upon the limb above the wound, the wound should be **disinfected** or, better still, well **cauterized by heat** or by **fuming nitric acid** or **phenol**, or in some cases may preferably be **excised**. The wound should not be closed, but **kept freely open and allowed to bleed** as much as it will.

The method followed at the El Paso Institute in the **cauterization** of wounds is described by F. S. Cary as follows: Apply hot **bichloride**, 1:1000, or **boric acid solution** to the bitten part, or, having soaked it in the same, dry the part; then apply, with a cotton-wool mop shaped to fit the crevices of the wounds, strong **phenol solution**; immediately take another mop and apply **nitric acid**, whereupon a slight, explosive puff takes place; after this neutralize the nitric acid with a saturated **solution of sodium bicarbonate**, and wash off with **alcohol**, which arrests the action of the carbolic acid. Dress the wounds dry, retaining the compress in place by a bandage or adhesive plaster. In some cases collodion application may be used. If the slough or scab is sterile, as is often the case, further applications should be avoided.

The wound should be **encouraged to bleed as freely** as possible for several minutes, then covered with a wad of cotton saturated with a mild **antiseptic solution**, such as a mixture of equal parts of **alcohol** and water with a small percentage of **iodine**. Only such pressure should be used as is required to control bleeding and protect the wound from further infection, and the cotton should be kept moist. When the area is small, the application of an **antiseptic wool-fat ointment** after the bleeding has been controlled may be of use. Where the wound does not bleed, a **suction pump** (similar to a cupping pump) should be applied, or, if there is none at hand,

cautious suction with the lips may be made, any danger which might attend this being eliminated by holding in the mouth the alcohol, water, and iodine solution, while the lips are held over the infected area. When suction does not produce bleeding, the poison is being carried in the lymph-channels, and an **antiseptic wool-fat ointment** should be applied. After the wound has been dressed, analgesics and stimulants may be given, if required. In the average case the writer gives 0.6 Gm. (10 grains) of **sodium salicylate** in combination with 0.05 Gm. ($\frac{1}{4}$ grain) of **caffeine sodio-salicylate** every 3 to 5 hours. Lesser (Amer. Jour. of Surg., Aug., 1912).

Investigating the various caustics used in local prophylaxis, the writers deemed **fuming nitric acid** best, especially for bites treated late. It produces little scarring. The wound should previously be **squeezed** to encourage bleeding and thoroughly washed with 1:1000 **mercuric chloride** solution, with a **wet dressing** of the same applied afterwards. Regan and Silkinan (Arch. of Diag., Apr., 1919).

In a fatal case, the wound had been merely swabbed with iodine and rinsed with Van Swieten's solution. The author advocates local treatment similar to that for snake bites, the wound being washed with a 1:60 solution of **sodium hypochlorite** and 8 or 10 injections of the same made around the bites after placing a constricting band around the limb. Degraive (Bull. méd., Mar. 11, 1922).

Warning against neglect of immediate local measures, in spite of the almost universal success of protective inoculation. The wound should preferably be **sucked out** by the victim himself or by another person; no risk attends this if there are no abrasions of the mucous membrane. Liquid caustics are effective. The silver nitrate stick should not be depended upon. W. Baumgarten (Deut. med. Woch., July 14, 1922).

At the time of onset of the first symptoms of hydrophobia these local

measures may properly again be resorted to should any evidence of irritation of the wound be present. The patient should be kept in a darkened room and free from any sources of irritation or annoyance. Restraint of any kind is not necessary, there being, contrary to common belief, little or no tendency on the part of the patient to injure others, and there is no danger of those in attendance contracting the disease. The patient should not be forced to make attempts at swallowing food or drink. **Nutrient enemata** should be employed, and large quantities of water be given by the rectum.

Local applications of cocaine to the fauces and pharynx are said to prevent spasm and enable the patient to swallow.

Case of rabies in which 10 c.c. ($2\frac{1}{2}$ drams) of 1 per cent. aqueous solution of phenol were injected into the subcutaneous tissues of the abdominal wall by means of an Ehrlich-Hata syringe at 8.30 P.M. on the day of the attack, which occurred five weeks after the dog-bite. At 9 P.M. 10 c.c. ($2\frac{1}{2}$ drams) of a 2 per cent. solution were injected similarly and repeated in an hour. At 11 P.M. there was a very perceptible improvement in the patient's condition. Hourly doses of the 1 per cent. solution were now resumed and administered until 8 A.M. A total of 11 doses, therefore, of the 1 per cent. solution and 2 doses of the 2 per cent. solution were administered, or, in the aggregate, an equivalent of $1\frac{1}{2}$ Gm. ($22\frac{1}{2}$ grains) of pure phenol. At 2 A.M., six hours after beginning treatment, the patient became somnolent, and when aroused was able to swallow readily. At this hour he was aroused for the first time by the insertion of the large-caliber needle. He stated that he now was conscious of his surroundings for the first time since early evening

and, when reminded of his previous actions and statements, denied any realization of them. He was catheterized at 2 A.M., about 8 ounces of urine being recovered, which contained a trace of albumin, but was otherwise normal. He did not require catheterization again, and subsequent specimens were normal. On the fourth day the patient was out of doors, and on the sixth day resumed work, there being no further sequela than a few days' prostration, which reasonably may be ascribed to excess muscular activity. There were no evidences, locally or generally, of any deleterious effects of the exhibition of the phenol. Haberlin (N. Y. State Jour. of Med., Sept., 1913).

During the violent spasms chloroform may be used by inhalation, and the administration of bromides and chloral by the mouth and of morphine hypodermically are followed by some amelioration of the acute symptoms. Curare, in $\frac{1}{10}$ - to $\frac{1}{4}$ -grain (0.006 to 0.016 Gm.) doses every half-hour until muscular relaxation occurs, is lauded by some. All such remedies are, however, merely palliative and exert no influence over the course of the disease.

Case of rabies in a girl, aged 13 years, in which, the customary sedative drugs proving ineffective and the prognosis being apparently hopeless, an intravenous injection of 0.3 Gm. (5 grains) of **salvarsan** was administered. Eight hours later pharyngeal and laryngeal spasm had entirely disappeared, slight dysphagia alone remaining.

On the following day the general hyperesthesia was likewise missing. The effect is believed by the author to have been a destruction of the living virus of the disease, without any influence on the toxins already elaborated, which remained to produce the secondary paralytic symptoms. R. Tonin (Il Policlinico, July 14, 1912).

In Egypt, the symptoms are treated with **scopolamine** and **morphine**, and when their violence is controlled, intravenous injection of **neocarsphen-amin** or **tartar emetic** is resorted to. Dolbey and El Katib (*Lancet*, Mar. 15, 1924).

PREVENTIVE INOCULATION.

—The work of Pasteur in developing the treatment of rabies by preventive inoculation constitutes by far the most important addition to our knowledge of the nature of the affection and the possibilities of its cure which has been made since the disease was first recognized. Pasteur found that the toxin in the spinal cords of rabbits which had been killed by rabies inoculation gradually lost its virulence if the cords were kept for some days under antiseptic precautions; so that after about two weeks the cord was no longer poisonous, inoculations from it failing to produce the disease. This fact offered, then, a method of gradually establishing an immunity by inoculating the infected animal with cords which had, to a certain degree, lost their virulence through preservation in this way.

This production of artificial immunity constitutes the widely and successfully employed **Pasteur treatment** for rabies, persons bitten by mad dogs being carried through a series of inoculations with the spinal cords of rabbits.

In the original Pasteur procedure, the inoculation is begun with cord which has been kept for 14 days; the second day, cord 13 days old is employed; the third day, 12-day-old cord, and so on until cord 5 days old is reached, when a new series of inoculations is commenced with 9- or 10-day-old cord. In the "intensive" method, the strengths of cord used are increased more rapidly.

Further experience has shown, however, that the weaker attenuations of cord can be

advantageously dispensed with. Some have even used simple dilutions of virus of the highest possible virulence (fixed virus) for immunization. At the Institut Pasteur, Paris, 5-day cord is the weakest cord used, progressing to 2-day cord as the strongest. In the United States the schedule laid down by the Public Health Service is frequently used: On the first day 3 injections of 8, 7, and 6-day cord, respectively, are given; second day, 2 injections of 6 and 5-day cord; third day, 5 and 4-day cord; fourth day, 3-day cord only, and so on until the eighth day, when 1-day cord is reached; then 5-day cord is begun again, and the virulence again increased to 1-day cord by the twenty-first day. The dose of cord emulsion is uniformly from 1 to 2.5 c.c. (the latter dose being used regularly in adults, and a slightly smaller dosage in children). The injections are made in the abdomen or arm, with the usual aseptic and antiseptic precautions.

Study of personal cases and a review of the literature led to the conclusion that, in rare instances, some form of paralysis may be the direct result of the Pasteur treatment. Some neurologists hold that this is a myelitis; others, a neuritis. This complication is exceedingly uncommon. Out of 567 persons treated at the Hygienic Laboratory, paralysis occurred in only 2 instances, whereas a series of 7080 treatments investigated by Jones did not show 1 case. Recovery having eventually followed in nearly all cases so far reported, the fear of this complication should not deter one from administering antirabic serum whenever indicated. Hasseltine (*Public Health Reports*, Oct. 24, 1913).

The author urges that after Pasteur treatment the patient be kept under supervision, and another course of injections given if the least abnormal sign develops, such as local pain or periods of unusual mental depression or buoyancy, or both. Mallet (*Bull. Soc. méd. des hôp. de Paris*, Feb. 25, 1921).

After from one to several weeks of this treatment the patient is regarded as immune, and the subse-

quent development of rabies is but slightly to be dreaded. The treatment should be begun as soon as possible after the injury, and the chances of failure are least in subjects in whom it is started within the first week, since it will then take care of cases with relatively short periods of incubation.

Of 14,000 persons inoculated, only 70 died of the disease, these fatal cases being chiefly persons who came for treatment months after the bite had been received.

A number of departures from the exact Pasteur method have been made, frequently with no impairment of the results. Thus, the virus has been attenuated by heat, instead of by drying, or by the action of glycerin, or by that of phenol. In the latter instance there is produced what is termed **phenolized vaccine**, which has been somewhat extensively used. The vaccines are commonly put up in vacuum containers which hinder deterioration during the period elapsing before use.

In man the writers had as good results with **phenolized vaccine** as with the dried cord treatment. W. F. Harvey and H. W. Acton (*Ind. Jour. of Med. Res.*, Apr., 1923).

In the years 1920-1921, in which Puntoni's method of injecting **phenolized vaccine** of increasing virulence was employed in Rome, the mortality from actual failures of the method in 1347 patients was reduced to zero. Leccisotti (*Policlin.*, Nov. 19, 1923).

Some observers employ **rabies serum**, obtained from animals immunized by injections of the virus. This is in no sense a substitute for the Pasteur treatment, but has at times been added to it.

Pasteur's suggestion of **immunizing dogs against rabies** has been applied on a large scale in Japan and to some extent in the United States, with excellent results. Usually a single in-

jection of rabies vaccine is given. Failures of the measure to protect are very few. An immunity lasting at least one year is afforded.

Report of 104,629 inoculations in dogs in Tokio, Yokohama and their environs, with the result that only 41 of these developed rabies, as against 1699 cases in uninoculated dogs, although the latter constituted but $\frac{1}{3}$ of the whole number of dogs in the districts. In the 41 cases referred to it is believed the infection must have been active before the inoculation was given. S. Hata (*Jour. of Immunol.*, May, 1924).

The number of reported rabid animals in Massachusetts has increased 1000 per cent. in 8 years. The stray dog is responsible for the spread. Every community should be active in disposing of unlicensed dogs. **Zone quarantine** when an outbreak of rabies occurs is advocated, all dogs except those immunized against rabies being kept at home or taken out only on leash for 90 days. Muzzling is not generally approved, since the muzzles seldom fit and place the muzzled, licensed dog at a disadvantage when attacked by a rabid dog which is usually a stray and therefore unmuzzled. G. H. Bigelow and W. G. Webber (*Boston Med. and Surg. Jour.*, Sept. 25, 1924).

E. D. BONDURANT,
Mobile, Ala.

RACHITIS. See BONES, DISEASES OF.

RADIUM. See X-RAY AND RADIUM.

RAREFIED AIR, DISEASES DUE TO.—ALTITUDE SICKNESS; MOUNTAIN SICKNESS; BALLOON SICKNESS.—DEFINITION.—The term "altitude sickness" better than any other describes a series of symptoms resulting from diminution of the atmospheric pressure when high altitudes are reached, whether by climbing or during aerial navigation. See also AVIATORS' SICKNESS, Volume II.

SYMPTOMS.—Altitude sickness affects persons unaccustomed to existence in elevated countries, when, according to Liebig, the altitude exceeds 10,000 feet. The symptoms are: Rapid pulse, rapid breathing, sometimes with irregularity approaching the Cheyne-Stokes type; headache; an elevation of temperature of 1 or 2° F.; feelings of constriction and weariness; in a higher degree, giddiness, nausea, loss of strength in the legs, finally engorgement of the venous system and the escape of blood from the superficial capillaries. When very high altitudes are reached, hemorrhages from the nose, mouth, and ears occur in addition to the more serious symptoms described, and death may ensue. At high altitudes there is steady loss of weight for a time.

After a few days, usually five, the body appears to have adjusted itself in part to its surroundings and the symptoms then begin to abate. If the altitude is not too great, a time comes when no abnormal symptom is experienced. Douglas, Haldane, Henderson, and Schneider, in observations at the summit of Pike's Peak (14,109 feet), found that after two, three or four days distinct signs of acclimatization occurred. The symptoms experienced had been as follows: Their faces and lips became blue, and they suffered from nausea, intestinal disturbance, headache, fainting in some instances, periodic breathing, besides great orthopnea on exertion or on holding the breath for a few seconds.

PATHOGENESIS.—Among the outstanding immediate physiological modifications resulting from high altitude are deepening and acceleration of the respiration, rapid heart action, and increased rapidity of blood-flow. The pulse-pressure increases, chiefly because of a fall in the diastolic pressure. The disturbance has been variously ascribed to insufficiency of oxygen, excessive output of carbon dioxide with decrease of CO₂ in the blood (Mosso), and disordered peripheral circulation of mechanical origin. The later observations have shown that oxygen lack is the chief, if not the only, pathogenic factor. According to Haldane, the difficulty lies not only in the diminished actual amount of oxygen in the blood but in the lowered partial pressure of the gas in this fluid, as a result of which oxygenation of the body cells becomes im-

perfect. The immediate functional changes in the circulation occur as an attempt at compensation. In actual acclimatization, according to Haldane, the epithelium of the pulmonary air-cells takes part actively by driving oxygen into the blood, thus making up for the reduced oxygen pressure in the air breathed in. There occurs also an initial mobilization of red cells and an increase of hemoglobin percentage due partly to loss of water from the blood. Later, the hematopoietic system assumes increased activity, with a resulting durable rise in the red cells, *e.g.*, to 8,000,000 or more at 18,000 feet.

TREATMENT.—**Oxygen inhalations** may be tried, having been found by aviators to dispel the symptoms due to high altitude. Mantegazza, who introduced the use of coca in medicine, informed the writer that he found that **chewing coca-leaves** prevented mountain sickness. The danger of acquiring the cocaine habit through their use is not great owing to the relatively small quantity of cocaine they contain, but its possibility should be borne in mind.

Haldane, as already noted, ascribes acclimatization to high altitudes to a secretory activity of the alveolar epithelium. This would coincide with the observation reported by Buckmaster and Gardner that the inhalation of oxygen does not materially augment the quantity of this gas in the blood. Apparently, a substance or secretion is required to enable the blood to take up more oxygen. Sajous has shown that this secretion is that of the adrenals. He therefore advocates the use of desiccated **adrenal gland** or, better, **pituitary gland**, which is more durable in its effects. By thus increasing the oxygen of the blood, the main untoward effects of high altitudes are in a measure counteracted. S.

RAT-BITE FEVER.—This is an infectious disease following the bite of a rat or, much less frequently, according to some reports, a cat, weasel, or ferret. In Japan, where the disease is commonest, it is known as **sodoku** or **sokosho**. Cases are also occasionally met with in America and Europe.

SYMPTOMS.—The incubation period ranges from 1 to 60 days, averaging 2 weeks. This is followed by one or more febrile attacks, with a characteristic rash, the paroxysms tending to recur regularly

every 4 to 14 days, and lasting 2 to 6 days. The temperature rises gradually to the second day, then falls by crisis, with profuse sweating. Along with the onset of the attack, pain and swelling develop about the bitten area, and the lymphatics become involved. Muscular pains and nervous symptoms, sometimes with paralysis of the lower limbs, are prominent features. There may be dysphagia. In some cases there is an exanthem of red or bluish-red macules 5 mm. to 10 cm. in size. In the intervals the patient feels almost well. In occasional cases there is only one attack, the fever lasting for several weeks, and being remittent or intermittent. Abortive and afebrile forms occur. The mortality is 10 to 15 per cent. The average duration in the cases that recover is 2 months.

ETIOLOGY.—The disease is believed due to the *Spirochæta morsus-muris*, or spirochete of Futaki, which is 1.5 to 5 microns long and 0.2 to 0.3 in thickness, with flagella at both ends. A definite diagnosis is made by demonstration of this spirochete in the blood during the attack, or in the bitten area, skin lesions, or enlarged lymph glands, or by inoculation of mice or guinea-pigs.

PROPHYLAXIS AND TREATMENT.

—The former consists in **immediate cauterization** of the wound with **fuming nitric acid**, **phenol** or the **actual cautery**, and the active treatment, in a course of intravenous injections of **arsphenamin**, which has proven promptly curative in a large proportion of cases. Of secondary but perceptible value is **mercury**. S.

RECKLINGHAUSEN'S DISEASE.—The generalized form of **osteitis fibrosa cystica**, or Recklinghausen's bone disease, has already been described under **BONES, DISEASES OF: OSTEITIS FIBROSA CYSTICA**, in Volume II (*q.v.*).

In addition, Recklinghausen's disease refers to what is also termed **generalized neurofibromatosis**, featured especially by discrete nodules in the skin ranging in size from a mustard seed to a billiard ball or even larger, and in number, from 1 to several thousand. There may also be freckles or larger dark-brown areas, even to involvement of the entire skin.

The nervous disturbances, next in frequency to those of the skin, comprise feeble-

mindedness or idiocy, dullness, and apathy; sympathetic disturbances such as tachycardia, tremors, sweating, and paresthesias; irregular or absent menstruation; neuralgic pains, and muscular weakness. Christin and Naville have collected 23 cases of *central neurofibromatosis*, with such symptoms as deafness and vertigo.

The disease is ascribed by many to an anomaly or injury of the ectoderm previous to its differentiation into cutaneous and nervous portions. It is maintained by some that endocrin disturbances are the underlying cause. Heredity is frequently involved; the condition may extend through 4 generations, with increasing severity. B. R. Tucker has observed a relationship to certain endocrin disorders, especially acromegaly manifestations, pituitary underactivity, or adrenal involvement. Necropsy in 1 case showed degeneration of the adrenal cortex and undeveloped ovaries. The blood-pressure was usually found low.

Ulceration, sepsis, and sarcoma are possible complications of the condition.

Treatment has so far been of little value aside from certain favorable effects sometimes seen from **adrenal** or other **endocrin therapy** where indications for the same could be discerned.

RECTUM AND ANUS, DISEASES OF. (See also **HEMORRHOIDS**, Vol. V.)

IRRITABLE ULCERS OF THE RECTUM, OR FISSURE OF THE ANUS.

DEFINITION.—Primarily, a superficial breach of the mucous membrane in the anal region, which, if unhealed, finally results in the formation of an ulcer of the bowel. This may involve both the mucous and submucous coats, and give rise to a spasmodic contraction of the parts and paroxysmal pain.

SYMPTOMS.—In the early stages the symptoms are not usually marked or even severe. They are generally experienced during defecation, when at some point or other there will be

an uneasy sensation, consisting of an itching, pricking, slight smarting, or a feeling of heat about the circumference of the anus. As the disease progresses the discomfort attending the movements of the bowel is greatly augmented; there may be severe pain, of a burning or lancinating character. This is followed by throbbing and excruciating aching, attended by violent spasmodic contraction of the sphincter muscles, continuing from half an hour to half the day. While the pain lasts the patient is usually incapacitated for work. The slightest movement sometimes greatly aggravates the suffering.

After an indefinite period the pain subsides or entirely disappears, the patient feeling fairly comfortable or even perfectly well, and to all outward appearance he would continue so were it not for the knowledge that the subsequent passage of fecal matter will bring with it a recurrence of agony. In consequence of this dread, the act of defecation is postponed as long as possible, with the result that when the evacuation does take place the pain is greatly increased. The feces, when solid, will be passed streaked with mucus and sometimes also with blood, and when more soft may be flattened and tape-like, due to the incomplete relaxation of the sphincters. Attention should be called here to a point which has a bearing upon the diagnosis of rectal lesions, to wit, that the tape-like and flattened appearance of the stools is rarely an evidence of stricture of the bowel. It may arise from any spasmodic muscular contraction, such as due to irritation from the presence of a polypus, fissure, etc. Special mention is made of this fact, because

the profession has been led to believe otherwise by reading the older textbooks, etc.

When a fissure is of long duration, the general health becomes greatly impaired as a result of the constant pain, the constipation, and the frequent resort to narcotics (always a mistake, as their use constipates and thereby aggravates the trouble), and the patient is liable to fall into a state of melancholy and extreme irritability. The countenance, expressive of pain, grows careworn and sallow; the appetite is poor; and there is more or less emaciation, associated with the general appearance of a person suffering from serious organic disease. Flatulence generally attends severe cases; it is not only troublesome, but painful, the passage of gas being almost certain to bring on a paroxysm of pain.

The ulcer is usually located just within the anus, beginning at the mucocutaneous junction (Hilton's line), and extending upward toward the rectum for a distance seldom exceeding half an inch. It may occupy any portion of the circumference of the anal region, but its usual site is at its posterior, or coccygeal, side. Although this lesion is usually solitary, we sometimes find it multiple, especially when of syphilitic origin.

DIAGNOSIS.—The signs are so characteristic of the lesion that it is almost impossible for a diagnostic error to be made. The peculiar nature of the pain, the time of its occurrence (either during or some time after an evacuation of the bowels), its continued increase until it becomes unbearable, and its gradual decline and entire subsidence until the next

evacuation clearly point to irritable ulcer of the anus, and in most instances should be sufficient to establish a diagnosis. Yet in numerous well-authenticated cases mistakes have been made and patients suffering from this disease have been treated for neuralgia, uterine or vesical affections, stricture, and even hemorrhoids.

This disease is very readily distinguishable from neuralgia by the absence in the latter of any breach of the surface or of any other disease of the mucous membrane of the rectum; by the entire want of connection between the pain and the alvine discharge, and by the constant suffering. In neuralgia the pain caused by pressure with the finger in the anus is not confined to one spot, as it is in fissure, but all parts of the bowel are alike tender.

The symptoms of anal fissure often simulate closely those of uterine disease and bladder affections. Spasm of the sphincters in these cases may also simulate stricture, but a thorough examination will dispel all uncertainty.

Frequently, uterine disorders or hemorrhoids are associated with the fissure; in this event the case is treated for either one or the other of the first two complaints, the presence of the other lesion being unsuspected and consequently neglected. In all such instances a careful inspection of all the parts will at once prevent all errors. Small polypoid growths are often found at the upper portion of the fissure, and unless removed will prevent successful treatment.

Among possible misleading symptoms of anal fissure, as pointed out by Svehla, are pain in the hepatic re-

gion or simulating appendicitis, apparent sciatic pains, and nervous manifestations such as irritability, restlessness, and headache.

ETIOLOGY AND PATHOLOGY.—Fissure is a disease of adult life, and is said to be more common among women than among men. Very young children, however, are not exempt, and my experience would lead me to suspect that it often exists in many such cases without being discovered.

The intense suffering entailed is due to the structural arrangement of the termination of the bowel, especially its nerve-supply. As is well known, the outlet of the intestine is closed by two sphincter muscles, the external being immediately beneath and parallel to the skin surrounding the margin of the anus. On the inner side, or rectal surface, the muscles are in contact, the line of union corresponding accurately with the junction of the skin and the mucous membrane. In most cases this junction of the sphincters is marked by a line of condensed connective tissue, and is known as "Hilton's white line." Attention is drawn to this term because of an important anatomical fact, which Hilton has pointed out in this connection: to wit, that it is the point of exit of the nerves, principally branches of the pudic, which descend between the two sphincter muscles, becoming superficial in this situation, and are there distributed to the papillæ and mucous membrane of the anus. These nerves are very numerous, and account for the extreme sensitiveness of the part and its abundant reflex communications with other organs (Andrews). The exposure of one of their filaments, either in the floor or at

the edge of the ulcer, is an essential condition of the existence of irritable ulcer. The upper portion of the rectum possesses very little sensibility, as the chief nerve-supply of the organ is at its termination and around the anus; hence it is that such grave diseases as cancer or ulceration may exist in the higher portions of the bowel and not manifest their presence by pain.

Irritable ulcers may arise from a variety of causes, such as atony of the muscular coat of the rectum, or other conditions leading to constipation. In these cases the bowel becomes impacted with hardened feces, which when discharged overstretch the delicate mucous membrane, and thus, either by irritation or by direct abrasion, the ulcer is formed. The late William Bodenhamer, in his masterly treatise ("Anal Fissure," 1868, New York) states that, in some cases of constipation, while the diaphragm and other abdominal muscles act with considerable energy, the anal sphincters remain more or less contracted, and yield but slowly, so that the indurated feces contuse and abrade the surface of one or more points of the mucous membrane, which abrasions, if they do not heal, lay the foundation of the disease.

Irritable ulcers sometimes result from the excoriations produced by vitiated and acrid discharges, such as occur in dysentery, chronic diarrhea, cholera, leucorrhea, etc. Hemorrhoids are frequently a predisposing cause and a complication. They narrow the outlet of the bowel, and through the successive inflammatory attacks to which they are subject the neighboring tissue loses its elasticity, is rendered brittle, and is much more easily lacerated.

Polypi are not uncommon causes; they are usually situated at the upper or internal end of the ulcer.

PROGNOSIS.—With proper treatment irritable ulcer can be promptly cured and practically without risk.

TREATMENT.—The first step is to establish regularity in the intestinal functions. **Enemas or mild aperients** should be employed and the **diet regulated**, the use of bland and unirritating food being enjoined. **Phenolphthalein**, in doses of 4 grains (0.26 Gm.) at bedtime, is a satisfactory aperient, as it does not gripe and produces a soft, mushy stool. All drastic purges should be avoided. To obtain a daily evacuation of the bowels and to render the movement as painless as possible, a 10-grain (0.65 Gm.) **suppository of iodoform** is to be used, followed in one-half hour by an **enema of rich flaxseed-tea**, from half a pint to a pint (250 to 500 c.c.). This should be administered every evening before retiring, the patient being then able to assume the recumbent posture, which, combined with the rest, affords the most relief from subsequent pain. Immediately after an evacuation of the bowels is obtained, another 10-grain (0.65 Gm.) **iodoform suppository** is to be inserted into the rectum, followed by another containing 3 grains (0.2 Gm.) of **ichthyol**. The iodoform suppository relieves the pain, and is far preferable to opiates, which tend to constipate. The ichthyol suppository allays the inflammatory condition usually present. If the enema should prove ineffectual, another should be employed in half an hour.

Palliative Measures.—Palliative treatment will meet with success in a certain proportion of cases, but only

when there is no great hypertrophy of the sphincter muscles.

Rigid cleanliness is essential. The anus and the adjacent portions should be carefully sponged night and morning and after each stool with hot or cold water, the temperature being regulated to suit the patient's comfort.

Whenever a fissure is complicated by the presence of a "sentinel pile," no local application will prove effective unless the pile is removed. This may be readily accomplished by injecting a few drops of a 0.25 per cent. cocaine solution about its base and snipping it off at the base with a pair of curved scissors.

Before applying remedies, the ulcer should be exposed and anesthetized with a 4 per cent. solution of **cocaine hydrochloride**, using a camel's-hair pencil to make the application, and repeating once or twice, at intervals of three or four minutes.

Among the remedies used, the following may be mentioned: **Silver nitrate**; **acid nitrate of mercury**; **fuming nitric acid**; **phenol**; **copper sulphate**; the **actual cautery**. Hirschman has employed with considerable success a 5 to 10 per cent. ointment of **scarlet red** every third day and found it an excellent stimulant to the formation of new epithelium. In my hands, the **silver nitrate** has proven most satisfactory. It lessens or obviates the nervous irritation underlying sphincter spasm; it shields the raw mucous surface by forming an insoluble silver albuminate, and destroys the hard and callous edges of the ulcer.

To attain the best results a strong solution, 240 grains (16 Gm.) to the ounce (30 c.c.) of distilled water, should be used once in two or three days, according to circum-

stances. It may be applied by means of cotton attached to a silver applicator or to a piece of wood, separating the margins of the anal orifice with the thumb and index finger of the left hand. The solution is to be applied to the ulcer only; a few drops are all that will be required. If thorough local anesthesia has been obtained the drug produces little, if any, suffering. After each application and daily thereafter until the ulcer is healed, a 25 per cent. **ichthyol ointment** should be applied to the ulcer. This can be used upon a probe on which a dossil of cotton is attached which is thoroughly saturated with the ointment. This is inserted in the anus, immediately over the site of the ulcer, and left *in situ*.

For immediate, complete relief from the symptoms, the writer recommends the following procedure: Through a sharp-pointed, 27-gauge needle connected with a small syringe, 15 minims (1 c.c.) of a freshly prepared 5 per cent. aqueous solution of **quinine and urea hydrochloride** are injected slowly beneath the fissure in such a manner as to raise it up. The rather severe immediate pain continues only for 30 seconds, after which the pre-existing rectal pain and discomfort completely disappear. Out of 30 cases thus treated, the fissure was cured in 27. A. B. Graham (Jour. Ind. State Med. Assoc., Feb., 1924).

Three-quarters of painful anal fissures are cured by **high frequency**, which should therefore regularly be tried before resorting to dilatation. MacIntyre's vacuum electrodes are generally used first, and later Oudin's or Delherm's electrodes. Delherm and Savignac (Paris méd., Jan. 26, 1924).

When this plan of treatment fails, resort to operative measures is indicated.

Operative Treatment.—There are three methods worthy of consideration in this connection: (1) *Forcible dilatation*; (2) *incision*; (3) *a combination of these two procedures*, to wit: *forcible dilatation and incision*.

FORCIBLE DILATATION.—This is the operation recommended by Récamier,

Van Buren, and others. It consists in introducing the two thumbs into the bowel back to back, and then forcibly separating them until the sides of the bowel are stretched as far out as the tuberosities of the ischii. It is essential to place the ball of one thumb over the fissure, and that of the other directly opposite to it, in order to prevent the fissure from being torn through and the mucous membrane being stripped off. This procedure should always be done with the patient thoroughly under the influence of an anesthetic, and it should occupy about five minutes.

The operation is a perfectly safe one, but as it is no less severe than the operation by incision, and as in some cases it fails to effect a cure, there is no advantage in adopting it instead. Permanent incontinence of feces has ensued from undue forcible dilatation, two such cases being reported by J. P. Tuttle.

INCISION.—The incision should be made through the base of the ulcer and a little longer than the fissure itself, so as to sever all the exposed nerve-filaments. The cut should divide the muscular fibers along the floor of the ulcer. When the ulcer is directly over the anterior or posterior commissure, it is much better to make a V-shaped incision at either of these points, as suggested by Samuel T. Earle, owing to the decussation of the muscular fibers at the former site, and of their tendinous prolongation to unite with the coccyx at the posterior commissure.

In a fair proportion of cases this operation will meet with success, but it is not so certain to result successfully as the operation next to be described. It has the advantage over

the other operations, however, of being nearly or entirely painless, under local **cocaine anesthesia**, by a hypodermic use of a $\frac{1}{4}$ of 1 per cent. solution, the injection being made directly beneath the ulcer and about its sides, using sufficient to produce the desired effect, as there is no danger from such a weak solution. When, therefore, general anesthesia is contraindicated or is refused by the patient, this method is worthy of a trial.

DILATATION AND INCISION.—This operation is a radical and unfailing cure. The bowels should be emptied by a dose of 10 grains (0.65 Gm.) of **blue mass** and the use of an enema of plain **normal saline solution**, after which, under general anesthesia, the sphincters should be dilated in the manner previously described. A straight, blunt-pointed bistoury should then be drawn lightly across the surface, making a cut extending about an eighth of an inch above and below the limits of the ulcer and about a sixteenth of an inch in depth. Usually it is a good plan to curette the entire floor of the ulcer in addition, and with curved scissors trim away any overhanging edges as well as remove any polypi present—even though they be small, as the presence of a polypus will usually prevent a permanent cure.

The after-treatment consists in keeping the patient in the recumbent position for twenty-four hours, and in cleansing the parts with **creolin solution** (a teaspoonful to a pint of water), and the application of a 25 per cent. **ichthyol ointment** to the wound, not oftener than once a day. In a week or so, the parts will be perfectly well.

FISTULA IN ANO.

DEFINITION.—An unnatural channel leading from a cutaneous or mucous surface to another free surface or terminating blindly in the substance of an organ or part.

VARIETIES.—For all practical purposes we may divide fistulæ into the following four forms: (1) the *complete*, in which there are two openings, one in the rectum and one on the skin more or less remote from the anus; (2) the *incomplete internal*, in which there is a communication with the cavity of the rectum by means of an opening in the mucous membrane, but none with the external surface of the body; (3) the *incomplete external*, in which there is an external opening through the skin, but no communication with the bowel; and (4) the *complicated*, or so-called complex, variety, in which there are many sinuses and numerous external openings. Some of these tracks run outward; some extend up the bowel beneath the mucous membrane; while others travel around the bowel and open in the other buttock, giving rise to the variety known as the horseshoe fistula. The second and third varieties named are frequently spoken of as blind fistulæ.

These classifications may be further subdivided, according to the character of the tissues involved, as *subcutaneous*, *submucous*, *submuscular*, and *subaponeurotic*. They may be *non-specific*, and due to infection by ordinary pus-organisms; or, specific when *specific* causes occur, such as tuberculosis, syphilis, and carcinoma.

According to the late J. P. Tuttle, the proportionate frequency of the different varieties may be said to be:

of those that are complete, about 70 per cent.; of blind external, about 20 per cent., and of blind internal, 10 per cent. of the recorded cases.

SYMPTOMS.—Occasionally there is considerable pain, but only when a track is blocked and pus has collected therein; more frequently only a feeling of uneasiness is experienced about the anus. When a fistula originates, as it commonly does, from a pre-existing abscess, there is a sensation of weight about the anus, with swelling of the integument, considerable tenderness upon pressure, pain in defecation, and more or less constitutional disturbance associated with rigors.

The chief discomfort is the discharge, which varies in quantity and may be purulent or mucopurulent. This discharge occurs from the sinus so long as it remains unhealed, soiling the linen and making the patient moist and uncomfortable. It often produces an excoriation of the nates. The discharge is not of itself sufficient to be a source of great exhaustion and does not interfere with ordinary occupations, so that many patients have had fistula for a considerable length of time without being conscious of any serious ailment. The escape of flatus and mucus from the sinus in cases of complete fistula will often prove a source of annoyance, as will also the passage of feculent matter, which may be expelled through the sinus should the track be large and patulous. An attack of secondary suppuration is always liable to complicate a fistula, and is usually due to a stoppage of the sinus by small particles of feces or by an exuberant growth of the granulation. Such a sequel, of course,

is attended with pain, until a new opening forms or one is made by the surgeon. In some cases the original fistulous track becomes re-established. Patients of neurotic habit often suffer mentally and from general weakness. As in other affections of the rectum, various reflex pains are experienced, which may be referred to the back, to the loins, and to the lower portion of the abdomen. When such pains extend down the leg and to the foot, they are liable to be attributed to sciatica, unless the history of the case is carefully studied and a critical examination is made.

DIAGNOSIS.—Prior to the examination of the rectum the bowels should be emptied by an enema. This procedure not only renders the exploration of the parts easier and cleaner, but also, in women especially, serves to quiet the patient's fears of any untoward accident occurring; and therefore facilitates the thoroughness of the surgeon's examination by securing the co-operation of the patient, as in extruding the parts, etc.

The patient should be placed in a recumbent position on a table or an examining chair, with the legs well drawn up toward the abdomen, and the buttocks brought to the edge of the couch. If the external orifice of the sinus is prominent, or if there is a sentinel granulation, the outlet of the fistula will be obvious; but when it is small and located between folds of the skin its situation may be demonstrated by making pressure with the tip of the finger in the suspected locality, which will usually cause a little drop of matter to exude. The site of a fistula may often be detected by feeling gently all around the anus

with the forefinger and finding an induration suggesting a pipe-stem beneath the skin. A flexible silver probe should now be passed along the fistulous track. In doing this considerable care is requisite and the utmost gentleness should be observed, the probe being directed by its own weight through the sinus and not forcibly. If it does not pass easily, it may be bent and "coaxed" along the channel. In the majority of instances it will pass directly into the bowel, and usually the internal opening will be found low down in the anal outlet just between the two sphincter muscles. When the probe has passed as far as it will go without the use of any force, the finger is introduced into the rectum. When it comes in contact with the free end of the probe it demonstrates the presence of a complete fistulous track. In other cases the mucous membrane is felt to intervene between the finger and the probe; in such cases the internal opening generally exists, but it is difficult to discover—sometimes because the examiner searches too high in the bowel. Palpation with the sensitive tip of the finger will often render the presence of the inner orifice obvious by coming in contact with an indurated mass of tissue. If such a spot be felt, the finger should be placed upon it and the probe passed toward the finger. There may not be an internal opening; if not, the operator should ascertain how near the probe comes to the surface of the bowel. If a doubt still exists as to the completeness of the track, any one of a variety of specula may be introduced into the rectum, but not until the outer orifice of the sinus is injected with a solution of iodine or

creolin. J. Rawson Pennington, of Chicago, advises methylene blue, and A. J. Zoble, of San Francisco, employs a saturated solution of potassium permanganate. If there be an internal opening, the appearance of the fluid within the bowel will set the question at rest. If a speculum be first introduced it may serve to, and often does, close these sinuses, so as to prevent their fluid from passing through. Should the inner opening not be discovered by these methods the case must be looked upon as one of external rectal fistula.

The injection of the potassium permanganate and methylene blue prior to any operation upon a fistula may render the track or tracks more obvious, and thus materially assist the operator in locating them.

When there are numerous external openings it is necessary to probe all of them so as to determine whether they are connected and the direction which they take. Sometimes more than one internal orifice exists.

The presence of an incomplete rectal fistula is more difficult to determine than the other varieties of this lesion which have just been considered. It is the most painful form, but fortunately it is of infrequent occurrence. Its orifice may be located anywhere in the rectum, but it is generally found between the internal and the external sphincters. According to the Allinghams, the circumference of this opening is often as large as an English three-penny piece, its edges being sometimes indurated, at other times undermined. The feces when liquid pass into the sinus and create great suffering—a burning pain often lasting all day after the bowels have acted. In this variety of fistula the

feces are coated with more or less pus or blood and a boggy swelling is noticed at some portion of the circumference of the anus. A peculiar feature of this swelling is often noted, viz., its presence one day and its disappearance in a day or two, followed by an increased discharge of pus from the bowel. This is explainable by the closure of the outlet of the fistula caused either by a plug of feces or as a result of inflammatory swelling which allows the collection of a quantity of pus and the consequent formation of the boggy tumor. The swelling disappears upon the re-establishment of the communication between the bowel and the sinus, and is attended by a profuse discharge of matter previously mentioned. This phenomenon is repeated over and over again, and, as a rule, is a pretty positive indication as to the nature of the disease. In some cases of blind internal fistula, if the orifice can be felt or if it can be seen through a speculum, a bent probe may be introduced into it and made to protrude near to the cutaneous surface of the body, where its point can be felt.

Fistulae frequently coexist with other rectal diseases; it is, therefore, important that an examination should be carefully made, so as to exclude such lesions as stricture, malignant or benign; hemorrhoids, tumors, etc. A thorough physical examination of the chest should also be made, to ascertain the presence or absence of phthisis, which so frequently complicates fistula in ano.

Serious kidney disease should be excluded before recommending operation, for obvious reasons. In cases of caries of the vertebræ, of the sacrum, or of the pelvis, fistulous tracks

may form and simulate anal fistula. In such instances a careful investigation will reveal the true origin of the trouble and show that the case is not one of ordinary anal fistula. In this connection attention should be called to the work of Dr. Emil G. Beck, of Chicago, in the employment of bismuth in the diagnosis and treatment of fistulous breaks, tuberculous sinuses and abscess cavities, by which means it is possible to skiagraph the entire track. A number of cures have been reported from the adoption of Dr. Beck's suggestion to use:—

R Bismuth subnitrate . 3j (30 Gm.).
White wax 3iss (5.9 Gm.).
Soft paraffin 3i¼ (5 Gm.).
Vaseline 3ij (60 Gm.).

Mix while boiling.

This formula is injected into a sinus and allowed to remain and harden.

For diagnostic purposes Dr. Beck used:—

R Bismuth subnitrate .
 (arsenic free) ... 3j (30 Gm.).
Vaseline 3iss (5.9 Gm.).

Mix while boiling.

He directs that the fistula be dried out as thoroughly as possible prior to using the paste, then a glass syringe loaded with the paste is tightly pressed against the fistulous opening and the contents slowly injected into the sinus until the patient complains of pressure. The treatment is continued as long as a discharge of pus recurs. I have not had the favorable results depicted by Dr. Beck and his advocates for this method, and numerous cases of nitrite poisoning have occurred from its employment.

ETIOLOGY.—Fistula in ano, which is not due to ulceration and

perforation of the rectal wall from within, is the result of a previous abscess, except in those rare instances, due to penetrating wounds, which extend from the exterior into the rectal cavity or adjacent parts, such as gunshot or bayonet wounds, etc. Such an abscess forms in the ischio-rectal fossa, and although opened early by a free incision, even before the cavity becomes distended with pus, it frequently fails to heal. It may fill up and contract to a certain extent, but it does not become obliterated; a narrow track remains, which constitutes the fistula.

There are several reasons why rectal abscesses so frequently degenerate into fistulae. One is that, owing to an internal opening communicating with the bowel, small particles of fecal matter find their way into the sinus, and, acting as foreign bodies, prevent the healing; another, that, owing to the frequent unusual movement of the parts, sufficient rest is not obtained for the completion of the reparative process; and, finally, the vessels near the rectum, not being well supported and the veins having no valves, there is a decided tendency to stasis, which is unfavorable to granulation.

According to Harrison Cripps, the surface of the fistulous track is lined with a smooth, gelatinous membrane, which, when examined under the microscope, is found to consist of granulation tissue exactly analogous to that which lines the interior of a chronic abscess. The leucocytes constituting the outer wall of this membrane are but loosely adherent, and, constantly becoming free, they form the chief part of the pus which drains from the fistula.

This disease is commonly met with during middle life, but it is by no means restricted to this period. The Allinghams state that they have operated upon an infant in arms and upon persons over eighty years old. Statistics prove that this disorder occurs much more frequently in men than in women. This fact depends, no doubt, on the former being more exposed to accidents likely to produce perirectal abscesses; that they pay less attention to their personal cleanliness, and that they are more liable to go to excess in eating and drinking.

COURSE AND PROGNOSIS.—

This disease, untreated, has a tendency to progress. The longer its duration, the more likely it is to become tortuous and complicated. Hence, the earlier the patient submits to treatment, the more favorable will be the prognosis. Again, the time and extent of the treatment necessary to effect a permanent cure will be correspondingly diminished.

TREATMENT. — Preventive.—

When a patient presents the symptoms of a threatened abscess in the vicinity of the rectum, he should be directed to go to bed, or at least to avoid all undue exercise; the bowels should be thoroughly evacuated, preferably by the use of a **saline**; the diet should be **nutritious**; and, if the case be seen early, **hot fomentations and poultices** may be applied to the parts. The early adoption of these measures may abort the threatened abscess, but very little encouragement can be given the patient.

If there be reason to suspect that pus has formed or is forming, it will be necessary to make a free **incision** into the center of the affected site

with a sharp, curved bistoury, if the trouble is superficial, or, if it is deep, with a narrow, straight knife. The earlier this is done, and the freer the opening is made, the less liability there will be of a fistula resulting. When pus is present and is deeply situated, the evacuation of the abscess will be aided by the introduction of the forefinger into the bowel; the swelling may thus be pushed forward, rendered tense, and made more apparent.

In opening these abscesses, local anesthesia may be used, but **ether** or **nitrous oxide gas** is preferable. The patient should lie on the side upon which the threatened abscess is situated; the upper leg should be bent forward upon the abdomen. When pus is present the operator should stand out of the line of its exit, for when the cavity is opened the pus often squirts out a considerable distance. After the matter has been discharged, the forefinger should be introduced into the abscess cavity for the purpose of breaking down any secondary cavities or loculi that may exist. If a general anesthetic has been employed, the wall of the abscess should be thoroughly curetted. When this has been accomplished the abscess should be washed with **bichloride of mercury solution**, 1:4000, or, **creolin solution**,—a teaspoonful to a pint,—after which a rubber drainage-tube should be inserted to allow free drainage; or a piece of iodoform gauze should be packed into the incision to prevent its closing too rapidly. Careful daily attention should be paid to the wound while the cavity of the abscess is contracting, as it is important to maintain a free and dependent outlet for the dis-

charge that may continue to be secreted. All packing and overdistention of the cavity should be avoided after the first dressing, *i.e.*, that employed following operation. If a drainage-tube be used, it should be shortened from day to day as the wall of the abscess contracts.

After an operation for rectal abscess the patient should be kept quiet for several days, but not necessarily confined to bed, as drainage is better when the patient is allowed to move around. If care be taken, both with the subsequent drainage and in keeping the orifice open, the parts may heal without the formation of a fistula.

Palliative treatment will be required where there is a positive refusal on the part of the patient to submit to an operation, and in persons whose general health is broken down and in whom the reparative powers are inadequate. Chronic alcoholism, albuminuria, diabetes, malignant disease, etc., are conditions in which operative measures may be attended with risk, and in which it may be advisable to resort to palliative measures. Phthisis is not a contraindication to operative measures, unless the fistula be a tubercular one. Such cases are rare, possibly one out of a thousand, the diagnosis being made by finding the tubercular bacilli in the discharge. There is a vast difference between a fistula occurring in the tubercular subject and a tubercular fistula. The rule usually followed is to operate in those cases of tubercular subjects in which the disease is quiescent, but to avoid such interference if the lung mischief is active.

Incomplete external fistulæ, and even complete fistulæ of somewhat

recent origin and not extensively indurated, may be cured by non-operative measures; but such treatment requires constant attention on the part of the practitioner as well as a willingness on the part of the patient to give sufficient time to the treatment. Even under such circumstances the process of repair is slow, and in many cases the result will not be perfectly satisfactory. It is true that fistulæ sometimes recover spontaneously or are cured by simple means, such as the mere passage of a probe used in examining the fistulous track; but instances of this kind are rare. In certain selected cases of fistula (very limited in number), a cure may be effected by **stimulating the sinus** and allowing **free drainage**. This is done so as to avoid the use of the knife, when possible. To obtain satisfactory results the following indications should be borne in mind: **That the external orifice should be kept perfectly free; that the sinus should be kept clean, so as to prevent putrefactive changes, and that an effort be made to excite a healthy action in the fistulous channel.** To meet the first indication, it is necessary to **dilate the outer opening of the fistula with sponge or sea-tangle tents, or with Lee's antiseptic slippery-elm tents.** The latter are made of selected slippery-elm bark and are compressed under high pressure. Owing to their non-irritating and demulcent properties, they are to be preferred. The second indication (that the sinus be kept clean, so as to prevent putrefactive changes) is best carried out by the use of **bichloride of mercury solutions 1:4000, or creolin solutions**, a teaspoonful to a pint (500 c.c.) of water. Such solu-

tions are injected into the sinus by means of a long, flexible silver cannula attached to an hypodermic syringe. The third indication (to excite a healthy action in the sinus) can be met in one of a number of ways. Anesthesia of the channel with an injection into the sinus of a 2 per cent. solution of **cocaine**, using the same syringe and cannula that are used for cleansing the fistula, is desirable. If the wall of the sinus is somewhat indurated, it is better to insert a small, flexible **curette** and scrape the wall of the fistula along its entire length; or **Mathew's fistulatome** may be used. The sinus is now prepared for some one of the various stimulating substances which have been recommended for this purpose. Among these may be mentioned **tincture of iodine**, or, what is still better, a solution of **iodine in ether**, being more volatile, escapes more rapidly, leaving the parietes of the fistulous track in contact with the pure iodine; **silver nitrate**, 240 to 960 grains (8 to 32 Gm.) to the fluidounce (30 c.c.); **copper sulphate**, a saturated solution, or **carbolic acid** mixed with equal parts of glycerin and water. These substances may be applied by means of cotton attached to a silver probe or to an applicator, or, preferably, they may be injected into the sinus by means of a syringe and silver cannula.

If the fistula be a complete one and the substance used be applied as an injection, the finger, covered with a rubber cot, should be passed into the rectum and made to block the internal orifice of the sinus, so as to prevent the escape of any of the fluid into the bowel. A firm pad placed over the anus and supported by a T-

bandage is useful in limiting the motions of the parts, due to the alternate contraction and relaxation of the levator-ani muscle. The chance of success in the palliative treatment of this disease will be greatly increased if due attention be paid to the general health of the patient; when circumstances render it possible, a change of air should be advised. The employment of any of these stimulating substances is always followed by an increase of the discharge for several days, and often occasions more or less discomfort. The intervals between treatments vary from three days to a week or ten days. Personally, I have not found these methods very successful.

Operative Treatment.—The surgeon should examine the patient carefully, not only locally, but also as to the state of his general health, for fistula in ano is not infrequently complicated with other lesions which may render operative procedures inadvisable. Thus, when a fistula is associated with a stricture of the rectum of a malignant nature any operative interference on the former lesion will be out of the question. If it be a simple stricture and its existence be not recognized, or if it be not treated, any operation performed on the fistula will usually fail to effect a cure.

INCISION.—In a number of instances the operation which is sanctioned by experience as the most prompt, certain, and safest, in its results, is to lay open the sinus in the rectum, dividing with the knife all the tissues intervening between its cavity and that of the bowel. The bowels should be moved the day preceding the operation, by means of **blue mass**, 10 grains (0.65 Gm.) at

bedtime, followed the next morning by a saline, such as citrate of magnesia, Epsom salts, etc.

After etherization, the patient should be placed on the back,—in the so-called lithotomy position, the buttocks being brought to the edge of the table. The first step in the operation is to dilate the sphincter muscle slowly, but steadily, by introducing the thumbs into the rectum, back to back, and making gradual pressure around the anal orifice until the muscular contraction is overcome. In male patients, the scrotal holder of Dr. Dwight H. Murray is a most useful instrument.

In dealing with complete fistulæ a flexible probe-pointed director is passed through the sinus, and is then brought out of the anus by means of the forefinger of the left hand introduced into the bowel. The tissues lying upon the director are then to be divided with a sharp bistoury. A careful search is now to be made for any diverticula, which, if found, should be divided. If none exists, the granulations lining the track should be scraped or cut away. The healing process will be greatly facilitated by removing with scissors all overtopping edges of skin and mucous membrane.

A frequent error in operating on fistulous cases consists in not keeping to the sinus, the director being pushed through the track-wall, and then being free to roam about in the cellular tissue of the part, at the operator's will. In this manner, a portion of the fistulous channel is left, and an unnecessary amount of the tissues is divided. Such a mistake can always be avoided by taking plenty of time in performing the operation and by

careful sponging of the sinus as it is laid open, in order to follow granulation-tissue lining the sinus, which by this simple means is freely exposed to view.

The method of treating external rectal fistulæ must vary according to the direction and extent of the track. If the mucous membrane alone intervenes between the finger introduced into the bowel and a probe passed along the sinus, the channel should be transformed into a complete fistula by perforating the mucous membrane with the probe or with a director, at the uppermost limits of the fistulous channel. The regular operation for complete fistula is then to be performed by dividing the intervening septum between the fistula and the bowel. In cases in which the sinus is directed away from the rectum, the proper course is to avoid division of the sphincters when possible.

The treatment of incomplete internal rectal fistula invariably demands operative interference at the earliest possible moment after a diagnosis is made, for if left alone its tendency is to burrow and occasion serious trouble. The operation for this variety of fistula consists in making it a complete fistula and in dividing the intervening structures between the bowel and the sinus. This is best performed by introducing a probe-pointed director, bent at an acute angle, into the bowel, and passing the bent portion through the internal opening. This done, the point of the probe can be felt subcutaneously and cut down upon and the remainder of the operation completed.

In dealing with complex fistulæ the surgeon must be guided by the pecu-

liarities of each case. In operating upon a horseshoe fistula it is important to recognize the true condition of affairs; for a careless or inexperienced observer might think that he had two separate fistulæ to deal with and operate accordingly.

Immediate Suture.—In otherwise healthy subjects, a method of operating which has not met with the success which was hoped for consists in the immediate suture of the wound after the fistula has been excised. The steps of the operation are as follows: The septum between the fistula and the bowel is divided; the entire fistulous channel and all lateral sinuses are excised; buried sutures of catgut, silkworm gut, or of silk are then inserted beneath the wound and around its circumference, at intervals of a quarter of an inch, and tied so as to bring the deep tissues together. The sutures are inserted very much in the same manner as in the ordinary operation for ruptured perineum. The advantage claimed for this plan is that primary union may be secured and the patient recovers in a shorter time than would have been the case after one of the operations which aims to secure union by granulations. The track so frequently becomes infected, however, probably from its proximity to the bowel and its consequent liability to infection from the entrance of fecal matter, and this complication has occurred so often in my experience, that I would advise extreme caution when this procedure is employed, for if the presence of pus is not promptly recognized, the state of the patient is worse than prior to operation. I have practically discarded the employment of this method for the reason mentioned.

Ligature.—This procedure is usually classed among the conservative or non-operative methods on the ground that the cutting is accomplished without recourse to the knife. Silk, linen, and elastic threads have all been used, but at present only the rubber ligature is employed.

The advocates of the elastic ligature maintain that it does not give rise to hemorrhage. This is a matter of considerable importance when the fistula penetrates deeply, and also in those rare cases of hemorrhagic diathesis, in which severe bleeding is apt to follow a trivial incision. The elastic ligature, for which we are indebted to Lee and Holthouse; later to Dittel, of Vienna, and in more recent times to Bodenhamer and the Allinghams, causes strangulation by the firm pressure it constantly exerts upon the included structures; it cuts its way out in a week's time or less. It is stated by those who have had an extended experience with this plan of treatment, that, contrary to what might be expected, the pain attending the ulceration of the band through the tissues is slight, especially after the first twelve hours. Consequently, this method would prove an excellent way of treating fistula if it were to be relied upon to effect a cure. Unfortunately, this is not the case, for it often happens that after the ligature has cut its way through, and the superficial parts have healed, the fistula remains uncured. The reason for this is to be found in the fact that the ligature has dealt with the main track only of a fistula in which exist one or more secondary channels or diverticula. It is, therefore, a measure to be resorted to only when there is an insuperable dread of any cutting

operation; when the fistula is uncomplicated with branch sinuses; in cases of deep fistula in which there is danger of wounding large vessels; in cases in which the patients are debilitated by some chronic disease; and, finally, in patients of known hemorrhagic tendency. It is a valuable adjunct to the use of the knife in dealing with cases in which a sinus runs for some distance along the bowel toward the superior pelvirectal space, but it is by no means a painless procedure, as some would have us believe.

The method of employing the ligature is as follows: A solid india-rubber cord, about one-tenth of an inch in diameter, is threaded to a probe having at one end a rounded opening or eye through which the ligature is passed. The probe enters the fistula from the external to the internal opening, and passes out through the anus. To facilitate the passage of the rubber it should be put on the stretch. After the ligature is passed, a ring of soft lead is slipped over the two ends of the cord; the cord is then tightly stretched and the ring slipped up as high as possible and clamped. If the internal opening be any distance up the bowel, the instrument devised by the Allinghams facilitates the passage of the ligature. It is intended to draw the cord from the bowel out of the external orifice, and not *vice versâ*. Frequently by the time the cord separates the wound has become quite superficial.

This procedure is rarely employed by proctologists, and then only in those cases, previously attended to, in which the sinus runs for some distance along the bowel upward into the pelvis.

Pennington's Procedure.—J. Rawson Pennington, of Chicago, has described a method of operation which is calculated to avoid, or minimize, the possibility of incontinence following operations upon fistula, and which preserves the normal contour of the anus and the functions of the sphincter muscles. His method is as follows: The patient having been prepared in the usual manner, all of the fistulous tracks are injected (when deemed necessary) with some coloring solution, as methylene blue, to aid in searching out their course. Then all of the tracks external to the sphincter, except the one entering the rectum, are divided. A probe-pointed director is passed into the rectum through this track and an incision made on its distal (toward the skin) side. This cut should be made so as to include most of the fibers of the external sphincter, and to locate the transferred internal opening at or near the anal margin. Salmon's "back cut" should then be made on the proximal side of the track, especially if the fistula is of long standing, and the track is fibrous. Then a seton is passed through the opening entering the bowel and tied loosely around the tissues remaining undivided. The wound is dressed as after the ordinary incision operation for fistula. At the end of twenty-four or thirty-six hours it is redressed, care being taken that the opening entering the bowel is made to heal from the proximal toward the distal side. The object is to advance the fistulous track as far distally, or, toward the skin side, as the case will permit, so that it will pass through the fibers of the external sphincters, when the healing process is complete.

As a rule, the enlarged track entering the bowel, except that through which the seton passes, will soon close. When this occurs the seton may be removed; and, by the time the external wound is healed, the track entering the bowel will possibly have closed also. Should it not, at any later time, this little track, which will usually not be more than one inch in length, may be dissected out, and the remaining fibers of the muscle sewed together.

Should the seton be left *in situ* until the wound is completely healed, a small, non-secreting fistula will be seen entering the anal canal, which may be dissected out and sewed together at will. Sometimes this opening will give rise to no annoyance and finally close without further interference.

Should the remaining tissues in this case simply be divided, without dissecting out the track, mutilation of the contour of the anus and loss of control to a certain extent might follow. In such a case the entire track should be dissected out and the ends of the muscle united. This may be done either under local or general anesthesia. It is best performed, however, under the latter.

The question might arise: What is the use of the seton? Would it not be just as well, or even better, not to use it? Pennington thinks not. By using it, the opening into the bowel is transformed and transferred to a point near the skin and the incision, through its use, made to heal from the proximal toward the distal side; or, in other words, with it you can direct and greatly control the healing process and location of the final fistulous track.

The anus not being divided aids the healing of the external wound and prevents much of the contraction and atrophy usually observed after these operations.

By employing this method we simply have an external wound with which to contend. The anus is not mutilated nor disturbed to any great extent, and in some cases not at all, and the patient is usually up and around in a few days. Moreover, the action of the bowels is less liable to infect the wound.

After-treatment.—After the operation of incision, the wound should be packed with **iodoform gauze** and left undisturbed for twenty-four hours, to prevent subsequent hemorrhage. A pad of gauze, over which **carbolyzed oil** is spread, and cotton and a **T-bandage** are next applied. The subsequent dressing of the case should be daily attended to by the surgeon himself. The parts should be kept perfectly clean, and the wound syringed with a 2 per cent. solution of **creolin**, a teaspoonful to a pint (500 c.c.) of water. After this a single piece of **iodoform** (or plain) **gauze** laid between the cut surfaces of the wound will be all the dressing required. The healing process may be greatly retarded by excessive packing of the wound with lint, or delayed by the undue use of the probe. Such interference is to be avoided. If the granulations be sluggish and the discharge be thin and serous, it will be well to apply some stimulating dressing such as the simple **resin cerate** with 20 grains (13 Gm.) of **iodoform** to the ounce, or a weak solution of **copper sulphate** (2 grains—0.13 Gm.—to the ounce—30 c.c.), etc.

The surgeon should be on the watch during the healing process to avoid any burrowing or the formation of fresh sinuses. Should the discharge from the surface of the wound suddenly become excessive it is evident that a sinus has formed, and a careful search should be made for it. Sometimes it begins under the edges of the wound, at other times at the upper or lower ends of the cut surface, and occasionally it seems to branch off from the base of the main fistula. Pain in or near the seat of the healing fistula is another symptom of burrowing; when complained of, the surgeon should carefully investigate its cause.

After an operation for fistula the patient's bowel *should not be confined by the use of an opiate*. The natural dread on the part of the patient, of experiencing pain, the result of a movement of the bowels, will be sufficient to inhibit any action, and the usual experience of the rectal surgeon is that a laxative will be required. The bowels should be moved on the third day by ordering 10 grains (0.65 Gm.) of **blue mass** in the evening, followed by a **saline** the next morning. So soon as the patient feels a desire to go to stool an enema of linseed oil (6 to 8 ounces) should be given, which will tend to render the feces soft and fluid and hence render their passage easier. The patient should be kept in a **recumbent posture** until the fistula is healed; a **moderate diet** may be allowed these patients, as experience has proven that a too restricted one is not as beneficial as was formerly thought. In other words, a liquid dietary is not essential. The time required for a patient to recover after an operation for fis-

tula in ano varies with the extent of the disease. In an average case it will not be necessary to keep the patients in bed over three or four days, and as soon as possible they should be permitted to go out in the fresh air. Some cases may be operated on in the office under local anesthesia; such cases may get well without being confined to the house.

Much hemorrhage rarely follows an operation for fistula, but in some cases it may be necessary to ligate a large vessel. If there should be a profuse general oozing, the sinus may be packed with **iodoform gauze**, or, if necessary, the rectum may be plugged; for this purpose the Allingham's tie a string into the center of a large, bell-shaped sponge, which is passed into the bowel so as to prevent the blood from escaping upward into the colon. They then firmly pack the parts below with cotton dusted with **powdered alum** or **persulphate of iron**. In order to allow the escape of flatus, a catheter may be passed through the center of the sponge. As a rule, all hemorrhages following rectal operations are easily controlled by mild measures, such as the **local application of hot water**, of **ice**, or of some astringent, such as a solution of **adrenalin**, 1:1000.

Incontinence of feces is happily of rare occurrence, and follows only extensive operations, especially those in which the sphincter has been divided more than once. When it exists to any extent, it is productive of great annoyance to the patient, possibly more so than the original fistula. The application of the small point of the **Paquelin thermocautery** to the cicatrix of the operation wound will often suffice to relieve this trouble,

by causing contraction of the anal outlet and giving tone and increased power to the sphincter muscle. The Allinghams recommend for this condition freeing the ends of the muscle by a **deep incision through the old cicatrix** and allowing the wound once more to heal from the bottom by granulation. Kelsey advocates **complete excision of the cicatrix**, exposing freely the divided ends of the sphincter and bringing them together by deep sutures, exactly as in cases of a lacerated perineum.

PRURITUS ANI.

SYMPTOMS.—This subject is one of contention, the difficulty arising from the recognized authorities viewing the matter from two different standpoints: On one side we have men like A. B. Cooke, of Los Angeles, Cal., and Louis J. Hirschman, of Detroit, Mich., who assert that it is merely a symptom of some other malady and not itself a distinct lesion. Others equally eminent, such as Jos. M. Mathews, of Louisville, Ky., and Goodsall and Miles, of London, Eng., recognize it as a separate and distinct disease. Without entering into the merits of these divergent opinions, it will suffice for the purposes of this article to state that when a pruritus ani arises and requires a patient to consult a physician for its relief, all proctologists are in accord that nothing short of actual treatment of the itching will effect a cure, even though every other lesion thought to produce it be removed. For this reason, we have deemed the subject one worthy of consideration in a special article.

Pruritus ani may be classed among the most annoying of the minor affec-

tions. Though not painful nor dangerous to life, it may produce marked ill-health by interfering with rest. The severity of the disorder varies considerably, ranging from irritation to intolerable itching. Usually the pruritus occurs at night after the patient retires, and lasts hours.

The itching may be so intense that it is almost impossible to avoid scratching, which, instead of giving relief, adds to the trouble. Nervous and excitable persons are prone to attacks of pruritus during the day as well as at night, especially after exercise, or on leaving the cold air and coming into a warm room. In marked cases, a characteristic condition is the loss of the natural pigment of the part. The skin is not supple, but has a peculiar harsh and rough feel similar to that of parchment paper. It is frequently fissured from scratching.

Impairment of the general health often occurs in these cases, due frequently to broken sleep at night and to annoyances during the daytime. Neurasthenia, melancholia and insanity have been known to occur, and suicide has not only been attempted but effected.

ETIOLOGY.—The causes are both local and constitutional. In many cases it is impossible to discover any causative factor, and it may then be considered, as stated by the Allinghams, as a pure neurosis, occasioned or greatly aggravated by mental worry or overwork. Leucorrheal discharge often excites pruritus by remaining in contact with the skin of the perineum and developing an eczema. In children, especially, it may result from the presence of *Oxyuris vermicularis* in the rectum.

Pediculi, or scabies, may also occasion it, or it may be excited by improper diet and highly seasoned food.

Dwight H. Murray, of Syracuse, N. Y., believes that the cause of all anal itching is to be found in an infection from the *Streptococcus fecalis*. Extensive studies to support this view have been undertaken by Murray, which cover a period of over three years, to which reference will be made under the head of Treatment.

Jerome M. Lynch, of New York City, in a large series of cases, has found the presence of the *Bacillus coli* more frequently than the *Streptococcus fecalis*, and in three instances the *Staphylococcus* was isolated.

Hemorrhoids, polypoid growths, fissure, or fistula, from the irritation they set up and the abnormal secretion they produce, and chronic diarrhea or dysentery may occasion pruritus.

P. Lockhart Mummery, of London, Eng., speaking of leakage of moisture from the anus as a frequent cause of pruritus, calls attention to the fact that catarrhal proctitis is one of the commonest factors in the production of this moisture, and that it is a cause which is frequently overlooked, either because the surgeon is not acquainted with the proper methods of examining the rectum, or, owing to his not having the necessary instruments at his disposal essential for the investigation. This same authority asserts that the usual form of proctitis met with in these cases is the hypertrophic catarrhal variety, characterized by hypertrophy and edema of the mucous membrane, accompanied by an excessive secretion of acid mucus. He also states that there is another form of proctitis, in which the mucous

membrane appears congested and granular on the surface, that both of these varieties of proctitis are chronic and are usually unsuspected until an instrumental examination of the rectum is made. In both of them there is present an excessive secretion of acid mucus, the constant presence of which irritant material, in contact with the sensitive mucous membrane of the anal canal, he believes causes the pruritus.

Erythema, herpes, and any variety of eczema, whether acute or chronic, may also give rise to it. It has also been traced to stricture and inflammation of the upper portion of the urethra. It frequently depends upon a varicose condition of the hemorrhoidal veins, just as occurs in a similar condition of the veins of the lower extremity. Uterine disorder, uncleanness, and insufficient ablution of the anus, and, finally, the use of hard or printed toilet paper may excite it.

A. B. Cooke, of Los Angeles, Cal., thinks that, of all the constitutional causes, intestinal flatulence, with its accompanying constipation and catarrhal inflammation, is by far the most frequent. He states that this fact is deserving of special emphasis, for he has so often noted this condition in cases of pruritus ani, and so often have his efforts to relieve the latter resulted in failures and disappointment until the former received attention, that when the existence of this intestinal disorder is determined he regards its proper management the most important indication of the treatment of the case.

Gouty subjects and persons with a more or less marked lithic acid

diathesis are predisposed to attacks of pruritus ani. Hepatic disorders, which may or may not be associated with constipation, diabetes, and chronic constipation, frequently act as causes, while excessive smoking and the free indulgence in alcoholic liquids or of coffee may also induce it. Excesses at the table, combined with a lack of proper exercise, not only predispose to pruritus, but also may become its exciting cause. It has also been ascribed to disease of the spinal cord and brain.

Fred. C. Wallis, of London, Eng., believes that in over 90 per cent. of his cases the cause of the malady under consideration is the presence of a shallow ulcer, usually found between the two sphincters, more often in the posterior half than in the anterior anal canal, and generally near the dorsal midline. In some instances Wallis states that more than one ulcer exists and that in other cases there are found various clefts, which occasionally almost surround the bowel. The ulcer is not easily recognized by the touch and a certain amount of practice is required to appreciate its presence. When a specular examination is attempted the ulcer will appear as though higher in the bowel than it really is, by reason of the instrument used pushing the tissues in. Under these circumstances the ulcer can be clearly seen and appears as a shallow, oval, livid abrasion, differing markedly in color from the normal mucous membrane.

TREATMENT.—In the majority of instances, especially if there be no ascertainable local factor present, the affection must be treated by constitutional remedies as well as by local means. The Allinghams state that

the difficulty experienced in its treatment has arisen in a great measure from its having been considered as merely a local affection, and only local means having been applied for its relief.

If the patient shows a lithemic tendency he must be treated accordingly. **Out-of-door exercise** should be advised; the **diet** should be carefully **regulated**; meats should be taken in small quantities. Rich gravies, sauces, and pastry are to be avoided, as well as most sweets; malt liquors and all wines except claret are objectionable.

Turkish baths are beneficial when taken once or twice a week. General **massage** is also of advantage. Medicinally, the **lithium salts** are indicated, either in the form of **natural mineral waters** or the **effervescing lithium-citrate tablet**. In cases in which the irritation is very severe, the **wine of colchicum**, in doses of 5 to 20 minims (0.3 to 1.25 c.c.), every four to six hours, answers best. Cripps recommends the following formula of Brodie's:—

R Magnesia gr. vj (0.4 Gm.).

Potassium bicar-

bonate gr. xv (1 Gm.).

Potassium tartrate. gr. x (0.65 Gm.).

M. Sig.: To be taken with water twice daily, three hours after meals. The second dose may be taken with advantage on going to bed.

This must be persevered in for at least ten days in order to properly test its efficiency.

The Allinghams found that when gout, active or latent, was the cause of pruritus ani, the irritation was best allayed by the local use of a strong **solution of sodium bicarbonate** or of **sodium disulphite** (1 dram—4 Gm.—

to the fluidounce—30 c.c.—of water) frequently applied in a poultice.

In functional derangement of the liver, if dependent upon a gouty diathesis, the **diet** should be carefully regulated. The use of alcohol should be prohibited. Considerable benefit is to be derived from the use of aperient medicines, of which the salines are the best, as **sodium phosphate**, or the **sulphate**, or the **natural mineral waters**. In some cases marked improvement results from the use of **mercury** in some form, such as the fractional dose of **calomel** or **blue mass** in 5- or 10- grain (0.3 to 0.6 Gm.) doses. **Ammonium chloride** in 10- to 15- grain (0.6 to 1 Gm.) doses, four times daily, is a useful remedy in hepatic congestion. **Nitrohydrochloric acid** in combination with **nux vomica** and **compound tincture of gentian** or of **cardamom** often proves of value.

When chronic constipation is present the first step in correcting this condition is to instruct the patient to go at a certain hour every day to the closet, whether the desire exists or not. In most instances a morning hour will prove best, either before or after breakfast. **Physical exercise** is another important factor.

Certain articles of food to assist in the correction of constipation are often of value, such as the **fruits**, of which apples, prunes, and oranges are the best.

No one plan can be outlined that will benefit all, or even the majority of persons afflicted with constipation. The individual indications are the only means by which we can successfully gauge the remedies required. Some authorities are strongly opposed to the continual use of laxatives

in cases of obstinate constipation, but without their employment some patients would never have a bowel movement. Many inordinately use cathartics and laxatives, but this fact offers no valid objection to their employment by the physician when the patient is unwilling or unable to stand the expense and time necessary to be cured of constipation by other means. Sometimes a tumblerful of **hot or cold water taken before breakfast** will regulate the bowels. The hot water can be made most palatable by adding to it a pinch of salt. If this should fail, the **mineral waters** may be tried, especially the **Hunyadi Janos**, a wineglassful of which, followed by a half-tumblerful of hot water, may be taken. Fluidextract of **cascara sagrada**, with equal parts of **glycerin**, in doses of 30 to 60 drops at bedtime, will often prove useful. **Phenolphthalein** in capsules of 2 to 4 grains (0.13 to 0.26 Gm.) taken at bedtime is serviceable. (See also CONSTIPATION, volume ii.)

In intractable cases of pruritus ani, the urine should be examined for sugar.

The Allinghams state that when pruritus is of neurotic origin, as they think it frequently is, particularly in spare and delicate, excitable people, **arsenic** and **quinine** should be freely given, separately or combined. They should be pushed to their physiological effects. The internal use of opium in any form is contraindicated. Most authorities agree that though a night's rest may be procured by its employment, its use aggravates the disorder. This fact cannot be too strongly emphasized.

Local Treatment.—The pruritus induced by uterine catarrh can only

be permanently removed by the cure of the prime factor in its causation. Relief from the itching can be afforded by **cleanliness**, frequent washing of the parts, and by the use of **vaginal douches**. Various sedative applications may be tried, such as 1 part of the officinal solution of **plumbic subacetate** to 4 parts of water, applied three or four times daily by means of cotton pledgets; or a lotion composed of 1 ounce (30 Gm.) each of **chloroform**, tincture of **aconite**, and tincture of **opium** and 6 ounces (180 c.c.) of **olive oil** or **linseed oil**, which is to be shaken well before using and is to be smeared over the parts whenever the pruritus becomes annoying.

The elimination of *Oxyuris vermicularis* and the relief of any cutaneous inflammation about the anus which their presence has occasioned will materially assist the cure of the pruritus. To destroy the worms it is not sufficient to rely entirely on rectal medication, such as **enemas of lime-water**, weak solutions of **quinine** (20 grains—1.3 Gm.—to the pint—500 c.c.—of water), or of **corrosive-sublimate** solutions (1 part to 4000), for these only accomplish the destruction of the parasites in the rectum. In addition, it is essential for their complete eradication to add internal medication, so as to reach the seat of their propagation in the small intestine. (See PARASITES, INTESTINAL.)

When pruritus is caused by animal or vegetable parasites, it is readily cured by the application of the **sulphur ointment**, gently rubbed over the affected area at bedtime. The ointment should contain from $\frac{1}{2}$ to 1 dram (2 to 4 Gm.) of sulphur to the

ounce of benzoated lard, and it should be employed every night for a week, or ten days. The use of strong sulphur ointment for any great length of time is injudicious, as the cutaneous surface of the parts is apt to become irritated. A cleaner and an equally efficient remedy advised by the Allinghams is a lotion of **sulphurous acid**, of the strength of 1 part to 6 of water. Samuel T. Earle, of Baltimore, Md., recommends strongly the use of a 2 per cent. **ointment of salicylic acid** or one of 3 per cent. of Calvert's **carbolic acid** for the destruction of the fungus which produces the eczema invaginations, a not infrequent cause of pruritus ani, as microscopic examination will always make the diagnosis clear.

The removal of hemorrhoids, polypoid growths, fistula, and fissure will enable remedies applied for the relief of a pruritus to effect a cure, when otherwise the disease will prove intractable. Joseph M. Mathews ("Diseases of the Rectum,") has called attention to a fact which is worthy of emphasis, viz., that when pruritus is established, the treatment of any organ or local condition which caused the affection will not necessarily cure the pruritus.

The pruritus associated with varicose veins of the rectum may be relieved by measures calculated to tone up the part and to lessen any tendency to congestion. **Bathing the anus night and morning and after a movement of the bowels** will often accomplish this purpose. To prove efficacious a sponge must be soaked in cold or hot water and squeezed dry by pressing it against the anus. This procedure must be repeated about a dozen and a half or more times

at each bathing. Another excellent treatment is to use an injection into the bowel daily of about 2 drams (8 Gm.) of the following formula:—

℞ *Fluidextract of hamamelis* f℥j (30 c.c.).
Fluidextract of ergot. f℥ij (8 c.c.).
Fluidextract of hydrastis f℥ij (8 c.c.).
Compound tincture of benzoin f℥ij (8 c.c.).
Carbolized olive oil or linseed oil (oil, 5 per cent. carbolic acid) f℥j 30 c.c.).

M. Shake well before using.

Sig.: 1 to 2 drams (8 c.c.) as an injection.

Pruritus Ani per se.—All discoverable local or constitutional causes of this disease having been excluded, we are brought to the consideration of a class of cases, by no means small in number, to which the term “neurotic” has been applied. That the condition is due to a neurosis, reflex or otherwise, is a little difficult to confirm, but it is a plausible explanation, and is a theory warmly advocated by Mathews. These cases often tax the physician’s resources to their limit. What relieves one patient will utterly fail in another, and what gives relief for a time may lose its effect entirely. Furthermore, it is impossible to state, with any degree of precision, as to the form in which remedies should be used, for, as stated by the Allinghams, “in cases which appear best suited to ointments, the ointments may utterly fail, and a powder which you feared would be utterly useless may effect a cure.” Therefore they advise their readers “to ring the changes between ointments, lotions, powders, and caustics.”

Hot water applied as hot as can be borne to the region of the anus. while

it may temporarily increase the itching, acts as a temporary relief when employed at bedtime, **provided the parts be not rubbed.** It also paves the way for the application of other remedies by making the parts more susceptible to their action.

Among the curative remedies recommended may be mentioned **black wash, nitrate of mercury ointment, nitrate of silver** in solution, **chloroform, compound tincture of green soap, carbolic acid, calomel ointment, balsam of Peru, tincture of aconite** and of **belladonna** (equal parts), **camphor** and **carbolic acid** (equal parts), **menthol**, and the **hyposulphite of sodium.**

Goodsall and Miles, of London, Eng., have successfully treated two of these cases with pure **formalin.** They state that the application causes much pain and advise that the patient should be under the influence of an anesthetic when the drug is used. After the formalin has been applied they recommend the use of a strong solution of **cocaine** to the affected area. After an interval of four hours, **boric acid** fomentations should be commenced and should be continued until the parts are healed.

A plan of treatment which in my practice has proved most efficacious, is as follows: When the parts are found to be excoriated from scratching, etc., they are painted over with the compound tincture of **benzoin**,—which the patient is forewarned will cause momentary smarting, due to the alcohol in the preparation. If the skin has a harsh and dry appearance, the entire surface around the anus for several inches outward is painted with a strong solution of **silver nitrate** (often a saturated solu-

tion). In my experience, the use of a strong silver solution is not nearly so painful (though temporarily it smarts more) as the weaker solutions. The application of the silver may have to be repeated two or three times before the desired effect is obtained, not oftener, however, than every third day. By its use the skin becomes supple and healthy-looking. So soon as the parts permit, usually on the second or third visit, and thereafter, I spread over the anus and the cutaneous surface thereabouts, for a distance of about two inches, the citrine ointment (*unguentum hydrargyri nitratis*), U. S. P. IX. *The ointment is always used in its full strength.* Over the salve I place a wad of absorbent cotton, varying in size with the patient's comfort and convenience. The dressing is kept in place with a T-bandage. The patient comes to the office for treatment in the morning, and is advised to wear the dressing all day and night. If the itching should prove annoying during the night, direction is given to bathe the parts with hot water, as hot as can be borne with comfort, *but under no circumstances to rub or scratch the parts.* He is also told that the application of the hot water will momentarily increase the itching, but that he is not to scratch. After he has used the water, he is directed to use either a solution of black wash (*lotio nigra*), or, what is better in some cases, calomel ointment (10 per cent. calomel, with benzoinated lard as a base), either of which is to be applied locally to the affected parts.

Prior to coming to the office for the next treatment, he may wash the parts with Castile soap and hot water, but this is not essential as a routine

practice. In bathing the parts no rubbing is to be permitted.

For the first two or three weeks the patient is seen every day; then every other day, for a like period or longer time, frequently for six weeks, after which time once or twice a week will suffice until such time as I am satisfied that the disease is conquered. Usually this treatment consumes, in its entirety, not over six months. In no case should a definite promise be made to a patient as to the length of time the treatment will consume. Such a course, as a rule, leads to disappointment and dissatisfaction. It is perfectly proper to cite the experiences had with other patients with a like affection as examples of what may reasonably be expected by the patient about undergoing treatment.

I am also in the habit of warning patients that, at any time during the course of treatment, the itching may return suddenly and be as severe as at any time prior to coming under my observation, but that this must not be deemed a bad omen, as such occurrences are often experienced, and are not found to have any special significance.

Sometimes, during the use of the nitrate of mercury ointment, the anus and adjacent parts become sore. Under these circumstances the ointment will have to be discontinued for a few days; during the interim, I employ the calomel ointment, in the same manner as directed for the use of the other mercurial salve. I have never witnessed any bad effects from the use of mercury, such as salivation, etc.

To conclude, I will simply add that I have treated quite a large number of patients by this method, and that

I have yet to experience a single failure to effect what thus far has seemed a radical cure. Some of the patients have been treated as long as twenty years, but in no instance, so far as I have had knowledge, has there been any marked return of the trouble. In some few of the cases a patient has returned a year after his discharge for three or four treatments, owing to some slight sensations experienced about the parts, which he was afraid might portend a return of the old trouble, and wisely deeming that a stitch in time saves nine, sought advice before the much-dreaded affection had an opportunity to obtain another foothold.

Dwight H. Murray, having made a bacteriological examination in a number of cases of pruritus ani, came to the conclusion that a streptococcal infection of the perianal skin is the etiological factor in a large number of cases. He believes that the excessive moisture and the infiltrated condition of the skin are due to a low form of inflammation caused by streptococcal skin infection. Among 32 cases of pruritus ani in which no definite cause of the irritation could be found, and which were examined bacteriologically, he discovered streptococcal skin infection present in all, while in a series of control cases, in which no pruritus was present, he found no streptococcal infection of the anal skin. He claims good results for treatment with **autogenous vaccines**, but states that the ordinary stock vaccines are not to be depended upon, and that a special vaccine should be prepared for each case. In a series of very carefully recorded cases, marked improvement was shown in all treated in this way. If the streptococcal in-

fection was alone the cause of the trouble, one would reasonably expect that the number of real cures would have been greater. Dr. Murray's methods are, however, well worth trying in suitable cases. The following is the technique he advises:—

The perianal skin is first thoroughly cleansed with liquid soap and water, then with sterile water. The parts are next lightly dried, after which a swab is rubbed over the skin, particularly in any place where fissures exist. It is occasionally advisable to scrape the skin slightly with a curette, especially if bacteria fail to be obtained in the ordinary way. These swabs are then sent to the bacteriologist, who places them on Endo medium. The growth is examined after twelve hours, and usually a pure culture of streptococci (generally *Streptococcus fecalis*) is discovered.

A concentrated vaccine is made by transferring a colony from the Petri plate and allowing it to grow on slant agar for twenty-four hours, washing it off with an average of 1 c.c. of sterile salt solution, and then draining into a small bottle through cheesecloth. An equal volume of 1 per cent. carbolic solution is then added, and the resulting solution allowed to stand at room temperature for twenty-four hours before use.

This vaccine is to be injected subcutaneously, beginning with 2 to 4 minims (0.12 to 0.24 c.c.) to test the susceptibility of the patient. If no reaction occurs within twenty-four hours, a double dose should be given the next day. After a reaction has been obtained, the injection should be repeated as soon as the last reaction has disappeared,—injections being given into different parts. Murray particularly insists upon the importance of repeating the treat-

ment directly there is recurrence of the pruritus.

The only vaccines that appear to the author appropriate are those of the *Bacillus coli* from the deeper layers of the tissue, and the *Bacillus coli* with *Staphylococcus albus*. Vaccines are a general aid, but not as a substitute for procedures directed to the destruction of the infective focus. Gratifying results are fairly certain in cases featured by excoriations or erosions. He does not favor autogenous vaccines, but begins with the *staphylococcus albus* stock vaccines. If response is not obtained by the third injection, he uses the *bacillus coli* vaccines in addition. A small dose at the start, with a gradually ascending amount until a distinct reaction occurs, appears to be the best method of arranging the doses. When a distinct reaction, either focal or systemic, has been obtained, it is well to note the amount necessary to produce this and consider it the normal maximum dose for the individual. The vaccines may be given from one to three days apart. In some cases relief is rapid, and, if properly selected, all cases show a distinct palliation after the first 2 or 3 treatments. The vaccine therapy should be continued for 4 to 6 weeks after the primary palliation. The preferable method of administering vaccine is by subcutaneous injection through a small-gauge needle into the buttock, arm, or adipose tissue of the abdomen. J. F. Montague (Med. Jour. and Rec., June 18, 1924).

J. P. Lockhart-Mummery, of London, on the other hand, favors getting rid of the infection by direct local application rather than the use of an autogenous vaccine. He advocates the following procedure:—The patient's skin is tested for the *S. fecalis* by Murray's method, and if this is found, is treated by painting the anal skin with a 2 per cent. solution of iodine in 75 per cent. alcohol, and this solution is then driven into the tissues by cataphoresis in the same

way as ionization is carried out in the rectum. A moderate strength of current applied for fifteen or twenty minutes is generally sufficient to drive the iodine well into the skin; several applications are given at intervals according to the resistance of the patient's skin. If the treatment is given too frequently, the skin will be made sore, and may even become blistered; one must, therefore, go cautiously at first. This method appears to be the most effectual for sterilizing the skin in this neighborhood; it does not cause any pain, nor does it necessitate the patient's confinement. In the cases in which this method has been used, it has given immediate relief, although there has often been a recurrence one or two months afterward, necessitating a repetition of treatment. The procedure is certainly one well worth trying.

In treatment by ionization, the larger electrode, moistened in saline solution, is placed on the abdomen, and the smaller, active electrode saturated with a 0.5 per cent. medicinal solution at first, later sometimes raised to 1 per cent. Zinc permanganate is very effective for irritated, moist, blanched skins. Mercury and iodine solutions are also serviceable. The current is passed for 20 minutes 3 times a week. Out of 14 cases traced 18 months after treatment, 9 reported no itching and 4 very little itching. W. A. Rolfe (Amer. Jour. of Surg., Dec., 1921).

Violet rays and the X-rays have each been indorsed for the treatment of this affliction. Pennington reported a series of cases successfully treated by the latter agent. I have personally seen but little benefit from these measures. In several instances, an extensive dermatitis ensued from the use of the X-rays.

Various surgical procedures for the relief of pruritus have been devised and employed by many of the leading proctologists. Personally I have never been obliged to resort to these measures, but, in justice to the subject, will describe the same.

All of the various procedures have but one object in view, to wit, the complete division of the sensory nerve-supply of the affected area.

Lynch's operation is performed under local anesthesia, and in no way inconveniences the patient or enforces confinement. Lynch claims that it is not beset with possible complications as are other procedures; there is a minimum amount of scar formation, and the direction of the scar makes stricture impossible; the danger of sloughing is *nil*.

The patient is placed upon his left side, with knees and thighs flexed. At a point about $1\frac{1}{4}$ inches from the anus, a 1 per cent. solution of **novocaine** or a 0.2 per cent. solution of **cocaine** is injected.

An area extending to the posterior midline is anesthetized. At the point above mentioned a small, curved incision is made, about half an inch long and extending just through the skin. Through this incision a blunt-pointed dissecting scissors, curved on the flat, is introduced. With this instrument a blunt subcutaneous dissection is now carried out, working to the anus mesially and to the raphés anteriorly and posteriorly. When completed there is an area of skin, extending from the anterior raphé to the posterior commissure and involving all the skin within a radius of $1\frac{1}{2}$ inches from the anus, which has been deprived of its sensory nerves. Any bleeding may be

controlled by pressure. When the bleeding has stopped, a small piece of rubber tissue is introduced into the incision and permitted to remain twelve to twenty-four hours. Sometimes, in addition, a horsehair stitch is taken through the incision, but this is not usually necessary. As a rule, at the end of forty-eight hours, the wound is entirely healed. Either at the same sitting or at a subsequent time, the same procedure is followed on the other side.

The results, Lynch asserts, have always been satisfactory. Though there may be a recurrence, this is not likely to take place for two or three years. The itching ceases immediately, and perianal sensation being lost, the irritation soon lessens. With proper treatment all local conditions should promptly clear up. Lynch employs this operation only after all medicinal means have failed.

Alcohol injection is by far the best treatment. Under light general anesthesia by **ethylene**, **nitrous oxide**, or **ether**, injections of pure 95 per cent. grain alcohol are made over the whole area involved. Small hypodermic syringes with fine needles not over 1 inch long are used. The needles are plunged vertically through the skin, and the alcohol injected into the subcutaneous tissues, 2 to 4 drops at each puncture. The punctures are about $\frac{1}{4}$ inch apart and "stippled" over the entire area. They are carried to about $\frac{1}{4}$ inch from the anal margin. The scrotum, labia majora, and folds of the groins have been injected without resulting trouble. After completion of the injections, the area is sponged off with a wet alcohol sponge. No dressing is used. Most cases are relieved 6 to 12 months, after which the injections may be repeated. A few are apparently cured. A number had relief for several years. H. B. Stone (Surg., Gyn. and Obst., Apr., 1926).

PROLAPSE OF THE RECTUM.

The term "prolapsus," or "procidencia recti," signifies a protrusion or eversion through the anus of any part of the rectum, consisting of mucous membrane, either alone or combined with one or more of the coats of the bowel. Occasionally the protruded part contains within its folds a loop of the small intestine.

There are three forms of rectal prolapse: (1) prolapse of the mucous membrane alone [partial prolapse]; (2) prolapse of all the coats of the rectum [procidencia recti]; and (3) prolapse of the upper portion of the rectum into the lower, called invagination, or intussusception, in other parts of the intestinal tract.

PROLAPSE OF THE MUCOUS MEMBRANE.—In this variety the mucous membrane only is extruded, sliding away, as it were, from the muscular coat by the stretching of the loose submucous tissue which connects the two coats. The prolapse, in these cases, is necessarily limited, the protrusion being seldom more than an inch or two in length. This condition may occur at any age, though it usually occurs at the two extremes of life.

SYMPTOMS.—The prolapse may be immediate as a result of vomiting, coughing, etc., or it may come on more gradually. The more the bowel is protruded, the more the parts become stretched and relaxed and favor the repetition of the descent of the rectum. When the attack comes on suddenly, there is apt to be considerable pain, and a tumor-like mass, red in color, projects from the anus. Frequently, blood is seen oozing from its surface. If the prolapse be of one that has often occurred, the mucous

membrane shows evidences of superficial catarrhal ulceration. In some instances the submucous inflammation causes the surface of the protrusion to appear perfectly smooth, but usually the mucous membrane appears as bright-red folds, with sulci between them, which radiate from the anal aperture. At first the protrusion only occurs at stool, and is readily reduced; in some cases it becomes spontaneously reduced. In chronic cases it becomes more difficult to replace, and may occur independent of fecal action. In these cases the mucous membrane is greatly thickened and the submucosa more or less infiltrated; a mucopurulent discharge is common, while bleeding, though slight, often occurs. The protrusion of internal hemorrhoids is frequently associated with prolapse of the mucous membrane; this condition, however, ought always to be readily distinguished from the disease under consideration. Hemorrhoids are more isolated and are much firmer to the touch.

Complete Prolapse, or Procidencia Recti.—When partial prolapse has repeatedly occurred, it is apt to result in the more serious form, in which all of the tunics of the bowel are involved. In some instances an extensive prolapse takes place suddenly as a result of violent straining. In both conditions the tumor forms a protrusion of variable size, more or less pyramidal in form, which projects from the anus. At its distal end is the opening into the bowel, and this opening is generally narrow and slit-like.

When the prolapse involves more than two and a half inches of the rectum, it is well to remember that

the peritoneum may be involved, and that, within this serous sac and included in the prolapsed portion of the rectum, a coil of the small intestine may be found. In this variety there is no invagination. This form of prolapse may assume extensive proportions, the greater portion of the colon being extruded.

The symptoms of complete prolapse are similar to those in the first variety, but are usually more aggravated. Mucus is present, and even pus may be found when this condition is associated with ulceration. Pain, when present, is not usually severe, as the mucous membrane here seems to be purposely endowed with a lowered sensibility. This fact accounts for the considerable amount of trauma which the rectal mucous membrane stands without producing much suffering, as is exhibited in advanced and extensive malignant disease of the rectum. When the peritoneal coat of the intestine is involved, the sac of the hernia, so called, is to be looked for upon the anterior surface of the protrusion, as the peritoneal pouch does not descend nearly so far upon the posterior as upon the anterior wall of the rectum. Where the protrusion measures more than three inches, Ball states that the mass is generally curved, the concavity looking toward the coccyx, and in extreme cases it may be arranged in a more or less spiral manner.

Prolapse of the Upper Portion of the Rectum into the Lower.—This disorder is called "invagination" or "intussusception" in other portions of the intestinal tract. It is described by J. M. Mathews as one "where the finger can be inserted into a groove

alongside of the base of a tumor so that a distinct sulcus is recognized, of more or less depth, at the bottom of which, if not too deep, the lining membrane of the bowel can be felt as it is reflected from the base of the protruding mass." In such a case the rectum has begun to fold upon itself; in other words, to become invaginated, or "telescoped," the upper part of the bowel always passing within the lower, at a point more or less distant from the anus, yet generally within the reach of the finger. This subject has been considered in the article on *INTESTINAL OBSTRUCTION*, vol. iv, and is mentioned here only for the sake of emphasizing the importance of recognizing the condition, especially as its treatment from a surgical standpoint differs materially from the operative procedures to be advised for the relief of the other two varieties of prolapse.

DIAGNOSIS.—Though it is a comparatively simple matter to diagnose a prolapse, mistakes are frequently made. In children, polypoid growths are more frequent than the literature would seem to indicate. In the adult, hemorrhoids may be mistaken for prolapse. Mathews suggests, in doubtful cases, that the adult patient be instructed to take an enema and to strain. If it be a prolapse of the mucous membrane, it will occupy most or all of the circumference of the bowel, with a certain degree of regularity. The bowel will be of a bright-red color, and if grasped between the fingers its folds can be easily pressed together, there being no well-formed tissue existing. In protruded hemorrhoids the prolapse is irregular and does not include the circumference of the bowel,

and oftentimes exists only on one side; and if the parts are seized a well-organized tumor can be felt, which can be circumscribed; the color is usually a dark blue. Another point to which Mathews directs attention is the size of the protruding mass. Simple prolapse is never very large, and where any of the coats of the rectum or all of its coats are included, the protrusion is much larger. A simple prolapse of the bowel does not usually remain out for any length of time, and a prolapse containing the coats of the rectum is very apt to remain out an indefinite time, or until reduced.

J. M. Lynch, of New York, mentions a valuable diagnostic factor in recognizing at a glance the difference between an incomplete and a complete prolapse,—in the former, the folds are sulci, are longitudinal and radiate from the center to the circumference, whereas in the latter variety the folds are circular.

ETIOLOGY.—Straining at stool is the most frequent exciting cause. Children are especially predisposed to prolapse, because the rectum is nearly vertical and the mesocolon is of considerable length. The unfortunate habit of placing a child upon a commode and leaving it there for a long time to establish regularity of habit is a rather common cause of prolapse. Stone in the bladder and phimosis, by the straining efforts produced at urination, are factors not to be overlooked in searching for the cause of this disease. It is often due to ascarides, to rectal polypi, and frequently to violent fits of coughing, as in whooping-cough.

In adult life the prolapse may be traced to some cause which leads to

unnecessary straining efforts, such as enlarged prostate.

PROGNOSIS.—When the mucous membrane alone is involved, a spontaneous cure is frequently effected; in children this result is more especially noticed. Mild measures often assist nature. In the aged or in the young, where hypertrophy has occurred to any marked extent, operative measures are usually required to insure recovery. It is well not to promise too much to these patients as to the time necessary to effect a cure, as some cases respond but slowly to treatment.

TREATMENT.—No matter what variety of prolapse we are dealing with, efforts should be made to **return the mass as speedily as possible.** In some cases considerable difficulty may be experienced. Children should be laid across the knees and the entire mass should be subjected to gentle, but steady, pressure for some moments, so as to reduce the bulk of the tumor by the squeezing out of the fluid contents. The central portion should be returned first; this is best accomplished by inserting the finger into the lumen of the bowel; then, by pressure of the fingers of the other hand, its remaining portions may be gradually pushed within the anus. Persistence in **taxis** will in nearly all cases suffice. In difficult cases, the suggestion of A. B. Cooke, of Los Angeles, will often prove of value and consists in the use of a **cone of toilet paper** placed over the well-lubricated index finger, which is **introduced into the aperture and pushed up into the bowel**, carrying the prolapsus with it. After which the finger is withdrawn, leaving the paper cone in place to be evacuated

at the next stool. When all efforts at reduction fail, an anesthetic should be administered, the **sphincter divulsed** and the **protrusion replaced**, or, if circumstances permit, a **radical operation** for the permanent relief of the trouble should be performed.

L. J. Hirschman, of Detroit, has employed and found most satisfactory **compresses, soaked with 1:1000 solution of adrenalin chloride**, applied with firm pressure to a prolapse, especially in cases where it has remained outside long enough to become swollen, edematous, and congested. Its use makes reduction comparatively easy by constricting the blood-vessels and greatly reducing the size of the protruded mass.

In some cases **artificial supports** are needed. A belt may be placed around the waist and an elastic band, having a solid or inflated pad attached, is passed between the thighs in such a manner as to press the pad against the anus. The anterior part of the band is divided so as to come up to the belt in front of each side of the genitals. Another form consists of a belt, half steel and half leather, buckled about the hips just above the trochanters, while a bent steel spring passes down behind and carries a pad to press against the anus. In temporary cases it assists the stability of the pad to draw the nates together with a broad strip of adhesive plaster (Andrews).

S. B. Powell recommends a plan which "consists in rolling in and **strapping the buttocks together with two strips of adhesive plaster**, extending sufficiently forward to secure a good hold. The child (or adult) defecates with these in position, is thoroughly cleansed after the

act, and new strips are applied. This method, which, in the hands of the inventor, has never failed, is based upon the fact that the relaxed sphincter is elevated and supported during the strains put upon it while the child is at play, and is protected from the lateral traction occurring in the squatting position assumed in defecation. It and the parts above gradually regain their contractile power, and ultimately become competent to fulfill their functions normally" (Andrews).

In all cases attention should be paid to **regulating the actions of the bowels**, and, instead of permitting the patient to sit in the usual position, **defecation should only be permitted either in the recumbent posture**, lying upon the back or side, **or while the patient is standing**. It is also of assistance for the patient to become accustomed to having the movement of the bowels occur the last thing before retiring, so that rest may be obtained immediately thereafter.

If possible, the cause of the prolapse should be ascertained. A catarrhal condition of the rectum, a polypus, oxyurides, a phimosis, or a stone in the bladder should always receive the proper treatment before a satisfactory result can be obtained in dealing with the prolapsus.

Astringent applications for the relief of prolapsus are generally useless. **Cold water applied to the anus**, either with a sponge or as a douche, is as serviceable a remedy as any drug. The astringent remedies advised, in this connection, are: **alum, tannin, sulphate or chloride of zinc, chloride of iron**, etc.

Cauterization, either by the actual

cautery or by the employment of the **nitrate-of-silver stick** in cases of partial prolapse, may prove a very satisfactory method. S. G. Gant, of New York, has successfully employed **nitric acid** for the relief of children suffering from this malady. The surrounding parts are first protected by vaselin, and linear cauterizations made by the acid applied by means of a glass rod; the length of the cauterized line and the distance beyond will depend upon the extent of the protrusion. At the completion of this procedure, a piece of gauze or cotton should be inserted into the rectum to keep the walls of the bowel separated and to absorb any excess of acid. **Excision of elliptical strips of the mucous membrane** is sometimes necessary and often suffices for effecting a cure. Hypodermic injections into the coats of the bowel are not to be advised. Vidal used **ergotin** thus with asserted success.

D'Espine's method advocated for complete prolapse in children. Under general anesthesia a long puncture needle is inserted 8 mm. ($\frac{3}{8}$ in.) laterally from the anal margin and passed along beneath the mucous membrane for 6 to 8 cm. ($2\frac{1}{2}$ to 3 in.), at which point 1.5 c.c. (24 minims) of **absolute alcohol** are injected. This is repeated on the opposite side, the punctures sealed with collodion, the buttocks strapped, and the child kept recumbent for 8 to 10 days, with the bowels constipated. Cure in 11 cases. E. G. Alexander (Ann. of Surg., Oct., 1922).

Gant's Posterior Proctoplasty.—This operation is advised in cases of severe prolapse. The patient is placed in an exaggerated Sims position and is given a general anesthetic. The parts are aseptitized and an incision one and one-half inches long is made just below and transverse to the coccyx,

and carried down to the rectum, which is freed from its posterior attachments. The sphincters are then divulsed, and, with the index and middle fingers passed as far as possible into the rectum, the bowel is pushed out through the opening made by the incision and pulled down as far as it can be protruded. A longitudinal incision, from two to four inches long, is now made through the rectal coats, and the bowel is shortened the length of this incision by bringing the angles of the cut together, thus making its direction transverse and closing it with the Lembert sutures of fine silk or catgut. Before inserting the sutures all hemorrhage must be arrested. The wound is then dusted over with aristol and the bowel replaced through the external incision, which is then closed with catgut.

The rectum should now be irrigated and dried and the intrarectal wound protected from infection by non-absorbable wool, dusted over with iodoform. Unless strict asepsis be maintained, the author of the method calls particular attention to the likelihood of its being attended by infection, abscess, and fistula.

Lockhart-Mummery Operation.—

The object of this procedure, like that of all other forms of proctoplasty, is to anchor the rectum by adhesion to the sacrum and surrounding pelvic fascia. In the hands of its author, it has proven most satisfactory in dealing with cases of prolapse of the first and second degree, and his experience with this method extends over a period of ten years. Not only is it essential to prepare the patient for operation in the usual antiseptic manner, but it is a matter of con-

siderable importance to insure that no action of the bowels shall take place for at most four or five days after operation; in fact, until steps are taken to effect that end. The patient is placed in the lithotomy position with a small sand-bag under the sacrum. A transverse incision, about two inches long, is made at a point about half-way between the top of the coccyx and the posterior margin of the anus, and the attachment of the external sphincter to the coccyx is completely divided. The incision is carried down toward the tip of the coccyx, a knife or blunt-pointed scissors being used, until the posterior rectal space is opened. On no account should the rectum be opened. Next, a gloved finger is inserted through the incision and the posterior rectal space is opened up by blunt dissection so as to free the bowel laterally, and the extent of this separation upward should, roughly speaking, equal the length of the prolapse when down. This done, a long strip of sterilized bismuth gauze (with a selvedge) should be carefully packed into all the separated areas of the posterior rectal space, the object being to leave sufficient gauze to prevent primary union between the rectal wall and the sacrum, but to avoid using an unnecessary amount as would cause pressure upon the rectum or be likely to produce sloughing. When the prolapse is large and of long duration, the separation should be carried into the space between the levator ani and between this muscle and around the bowel. Two or three strips of gauze should be used and the ends left hanging out of the posterior wound. A portion of the anterior wall of the mucous mem-

brane of the rectum just within the anus should be seized with forceps and tied with a ligature, so as to prevent any tendency to prolapse, as otherwise this portion is liable to prolapse into the patulous anus after the posterior wall has been fixed. If the anus is very patulous, some form of plastic surgery may be necessary, otherwise not. A plug of sterilized gauze soaked in ointment is passed into the anus to prevent any leakage, and the parts are dressed with antiseptic gauze.

After the operation the patient must be kept flat in bed and not allowed to get up for any purpose. A light and easily digested diet should be given until the bowels have been opened. The gauze should be left in place until the sixth or seventh day, and these pads of it should be slowly removed each day, fresh gauze being lightly packed into the space left. The object of the packing is to make the whole of the space opened up behind the rectus heal by granulation, so as to produce the maximum adhesion of the involved area. Subsequently the dressing should be done daily, and it should take the wound not less than three weeks to heal. About the sixth day the bowels should be opened by an oil enema, and care should be taken to prevent infection of the wound. Daily motions of the bowels from this time on should be secured so as to avoid any straining efforts.

The author of this operation has performed it a number of times for severe cases of prolapse, and thus far has had only one case of recurrence afterward, but this patient was cured by a second operation.

Mention should be made of ampu-

tation of prolapse, but it is a method seldom used except in those rare instances in which the prolapse is irreducible.

NON-MALIGNANT ULCERATION.

It is a matter of surprise that erosions of the mucous membrane of the rectum are not more frequently produced and become the starting points of ulceration, as a result of the irritation to which the bowel is exposed from the presence and passage of fecal matter as well as from infection of the tissues by pyogenic micro-organisms which are present in such quantities in the average intestinal tract. It is true that ulceration frequently exists and is not recognized; but, nevertheless, its frequency, compared with that of other rectal lesions, is rather infrequent.

SYMPTOMS.—Ulceration within the rectum, as a rule, occasions well-marked, though in no sense essentially pathognomonic symptoms. The same signs are often observed in cases of other lesions of the rectum. The doubts as to the nature of the trouble may readily be cleared by making a digital and specular examination. The symptoms noted are: pain, tenesmus, diarrhea (often alternating with spells of constipation), and discharge. These also suggest dysenteric attacks, and it is no unusual experience to see cases of ulceration treated for dysentery.

Cripps (*op. cit.*, p. 193) states that the degree of pain experienced is no indication of the severity of the disease, the suffering depending on the situation of the lesion rather than on its extent. Generally speaking, the nearer the anus it is situated, the

greater the pain. This is well exemplified in cases of irritable ulcers of the anus. In ulceration involving the anus, loss of control of the sphincters often occurs.

The diagnosis will receive due attention when the individual varieties of ulceration will be discussed.

ETIOLOGY.—Non-malignant ulcers of the rectum are usually classified into (a) the varicose; (b) the traumatic; (c) the dysenteric; (d) the irritable [the so-called fissure of the anus]; (e) the catarrhal, or follicular, and (f) those arising from general debility occasioned by Bright's disease, phthisis, diabetes, and starvation; also into (g) the tuberculous; (h) the chancroidal, and (i) the syphilitic.

The existence of the *varicose* and the *traumatic* varieties seems to be unquestioned by all authorities. It is true that varicose veins of the legs are often followed by ulceration, and that a similar condition of the hemorrhoidal plexus of veins is the precursor of ulceration of the rectum, which should be classed in the category of the predisposing causes of all ulcerations in this region. In all conditions which lead to ulceration primarily, the condition is attended by varicosity of the rectal vessels, which induces a stasis of the blood-supply, followed by congestion. Under these circumstances it is not likely that an ulcer of the bowel will occur without some form of traumatism.

The *traumatic* ulcer may be produced in a variety of ways, as from the introduction of foreign bodies through the anus; but much more frequently the initial laceration or abrasion is occasioned by hardened fecal masses, pieces of bone or wood,

nutshells, or some similar substance. Pressure of the fetal head during childbirth is a not unlikely cause. Retarded union following operative interference upon the rectum for the removal of hemorrhoids, polypi, etc., is another factor in producing ulceration.

The *dysenteric* variety, in the opinion of J. M. Mathews, is rare. He states that "if a long-continued irritation is kept up in the rectum from any cause, the result would be, of course, an inflammatory exudate, resulting, perhaps, in ulceration and stricture," but he states that, in searching for this as a cause, the evidence has not been such as to enable him to place it in the list as a cause at all for stricture of the rectum. What this distinguished author has to say upon the subject of dysentery as a cause of rectal stricture applies with equal force to ulceration. An attack of dysentery may, and often does, act as a predisposing factor in causing an ulceration of the bowel, but that we have a class of ulcers to which we can apply the term dysenteric I very much doubt.

The *irritable ulcer* of the rectum, known more commonly by the term "fissure of the anus," has been thoroughly reviewed.

Follicular, or catarrhal, ulceration may, according to Ball, occur in any part of the colon, but the seat of election is undoubtedly in the rectum and the sigmoid flexure. The solitary follicles become inflamed and disintegrated, and finally open upon the surface of the bowel, owing to the necrosis of the swollen tissue. Though small at first, these openings gradually enlarge, and small ulcers are formed, which do not tend to

heal, but spread, and finally involve the submucous tissue. These ulcers also spread by uniting. In some instances the muscular coat of the bowel has been perforated and the ulceration has extended into the bladder and the vagina.

Ulceration involving the rectum and arising from the *general debility* occasioned by Bright's disease, diabetes, uremia, and starvation requires no special description, as it presents no special characteristics.

The true *tubercular ulceration* of the rectum may be a primary process, but in the majority of instances it is a secondary manifestation of pulmonary consumption. These ulcers are caused by the disintegration of small tuberculous nodules deposited in the mucous and the submucous coats of the bowel. They are sometimes scattered and sometimes closely packed together. Such ulcers are usually of considerable size and are found in the rectal ampulla or at the anus. They are irregular in outline, more or less ovoid, with their long axis parallel to the vertical axis of the bowel and corresponding to the direction in which the vessels in this locality run. They have a peculiar appearance, somewhat difficult to describe. They do not secrete pus, but a thin, watery discharge, and are usually surrounded by a mucoid material.

Under the name of *lupoid ulceration*, which is now known as a rare and virulent form of local tubercular infection, Ball describes the so-called rodent ulcer as one in which the essential element is a chronic intractable form of ulceration in the neighborhood of the anus and genital organs. Cripps states that this dis-

case is seldom met with in the rectum, and that few instances of its recurrence are on record. S. G. Gant has called attention to the fact that this variety of ulcer is frequently confused with cancer of the rectum and with tubercular ulceration, owing to the severe pain experienced, the amount of tissue destroyed, and its tendency to break out again and again, as well as its liability to increase in extent in spite of all treatment. Young and old persons are alike subject to it. The same authority states that this ulceration is not always rapid in its course, some patients living for years, while the disease slowly spreads and death finally ensues as the result of hemorrhage or from a diarrhea and its attending state of exhaustion. It is a superficial form of ulceration, and the character of the discharge is principally serous, containing but little pus.

The *chancroidal* form of ulcer of the rectum is rarely seen in this country. I have seen but one such case. Messrs. Andrews state that in the hospital of Saint-Lazare, in Paris, they were shown numerous cases of chancroid of the rectum and the anus, caused by the practice of sodomy. These authors have also met with a few instances of this disease in cases of retrovaginal fistula in which the virus entered the rectum through the fistulous opening.

Regarding the *syphilitic* forms of ulceration of the rectum, it may be said that, in this country, at least, the only common manifestation is the mucous patch. The diagnosis of this variety of ulceration may be confirmed by the employment of the Wassermann reaction and the discovery of the presence of spirochetæ. It

is my belief that the mucous patch exists more frequently within the rectum than is generally believed. In the late stages of syphilis a form of ulceration occurs in the rectum which often assumes extensive proportions and results in the formation of stricture of the bowel.

TREATMENT.—In dealing with all cases of rectal ulceration rest is of primary importance, for the healing process will not take place if the patient be permitted to follow the usual habits of life. The medicinal treatment must be adapted to the nature of the lesion as well as to the relief of any general disturbance. In cases of simple ulceration the use of an **enema of flaxseed-tea** is of advantage in cleansing the bowel and to procure an evacuation. A pint or more may be used once or twice a day. An astringent injection may be employed, such as **fluidextract of hydrastis**, 1 to 2 tablespoonfuls to 6 or 8 ounces (180 to 240 c.c.) of water; a solution of **nitrate of silver**, 2 to 8 grains (0.13 to 0.52 Gm.) to the ounce (30 c.c.). Insufflation of various powders may be used with benefit, such as **iodoform**, **subiodide** or **subgallate of bismuth**; **calomel** and the **subnitrate of bismuth**, equal parts, etc. In this condition I have found the following injection valuable:—

R. *Fluid hydrastis*,
Fluidextract of ergot,
Compound tincture of
benzoin of each 2 dr. (8 c.c.).
Fluidextract of hama-
melis 2 oz. (60 c.c.).

M. Sig.: To be well shaken before using. One-half ounce (15 c.c.) at a time, to be injected into the rectum every day.

Pain can be allayed by the use of **iodoform suppositories**, 5 to 10 grains (0.3 to 0.6 Gm.) each, used every six

to twelve hours. Opiates are injurious and sometimes dangerous.

No plan of treatment with which I am familiar will do much toward permanently curing the tubercular ulceration. **Curettage** and the application of **iodoform** have been used with temporary success only. Similar results are given by most writers.

The **tuberculin** treatment is recommended by some authorities who claim marked benefit from its employment. J. M. Lynch, of New York, advises as the proper method of employing it as follows:—

Geometric Method of Administering Tuberculins.—To obtain an average proper increase of tuberculins, it is necessary that the increase be at all times a certain percentage of the previous dose,—usually 25 per cent. The first dose administered is $\frac{1}{100000}$ of a c.c. The dilution necessary to administer this small amount means that 4 bottles are needed, labelled respectively *A*, *B*, *C*, and *D*. By using $\frac{1}{2}$ c.c. of tuberculin and $49\frac{1}{2}$ c.c. of diluent (which is normal physiological saline solution to which $\frac{1}{2}$ per cent. carbolic has been added), a 1:100 dilution is obtained and is placed in bottle labelled *A*; 1 c.c. of solution *A* to 9 c.c. of diluent placed in bottle *B* produces a 1:1000 solution; 1 c.c. of this (contents of bottle *B*) added to 9 c.c. of diluent placed in bottle *C* represents a solution of 1:10,000; 1 c.c. of solution *C* added to 9 c.c. of diluent is placed in bottle *D* and produces a solution of 1:100,000. Of this solution *D*, 1 c.c. is the first dose; 1.25 c.c. solution *D*, second dose; 1.57 c.c. solution *D*, third dose; 1.96 c.c. solution *D*, fourth dose; 2.45 c.c. solution *D* is the last dose, but, as this quantity is too large

to inject, it is usual to make the dilution—instead of 1:100,000—1:50,000, thus administering half the amount, or, in other words, 1.26 of the 1:50,000, increasing the dose at this point by 25 per cent., and reducing the dilution so as to at no time give a greater amount than 2 c.c.

Protein therapy was employed by the writer with success in 3 cases of rectal ulcers. A marked focal reaction incidentally took place in the cases thus treated. L. von Friedrich (*Med. Klin.*, Nov. 30, 1924).

CONGENITAL MALFORMATIONS OF THE RECTUM AND ANUS.

The proportion of infants born with malformations of the lower portion of the intestinal track is comparatively small. Harrison Cripps states that 1 case occurs in about every 4588 births. So far as published reports show, males form the larger percentage of cases.

Malformations of the rectum and anus result from arrested development of the so-called gut-tract during the early stages of fetal life.

The most practical classification for the use of the general practitioner is that of J. M. Mathews:—

Congenital malformations of the anus: (1) narrowing or partial occlusion, (2) total occlusion, and (3) complete absence.

Malformations of the rectum: (1) partial occlusion, (2) complete obliteration, (3) unnatural termination, (4) complete absence of the rectum, and (5) communication with the vagina.

The symptoms are self-evident in cases of malformations of either the rectum or the anus. In all the varieties—except that of the partial

occlusion of the anus and in those somewhat rare cases in which the bowel opens into the vagina, urethra, or bladder, or in some abnormal, but external, surface of the body—there will be signs of total obstruction of the bowels, such as distention of the abdomen and possibly fecal vomiting. (See also TUMORS OF THE RECTUM AND ANUS.)

PROCTITIS.

Inflammation of the rectum may be caused by a variety of factors of which hemorrhoids, tumors, parasites, dysentery, and gonorrhea are the most common. The symptoms are those of inflammation in other regions, heat, fullness and pain, besides more or less marked tenesmus. The latter may be accompanied by frequent defecation of small quantities of feces containing mucus, pus, or blood. The inflamed mucosa of the rectum may prolapse. When there is ulceration, stricture of the rectum may follow. Ulcerative proctitis with stricture is generally of syphilitic origin, but may also be due to local tuberculosis or dysentery.

TREATMENT. Mild cases are best treated by rest in bed and liquid diet to avoid rectal irritation, and suppositories of opium and *donna* if there is pain. Irrigations with a very weak solution of silver nitrate or of argyrol are very beneficial. When the ulceration is severe, as is often the case in gonorrheal proctitis, insufflations of iodoform and daily irrigations with a 1:1000 silver nitrate solution should be tried. If this does not suffice, the ulcer should be cauterized by means of galvanocautery. When stricture occurs, dilatations with bougies may be

tried, but excision of the stricture gives more lasting results.

PERIPROCTITIS.

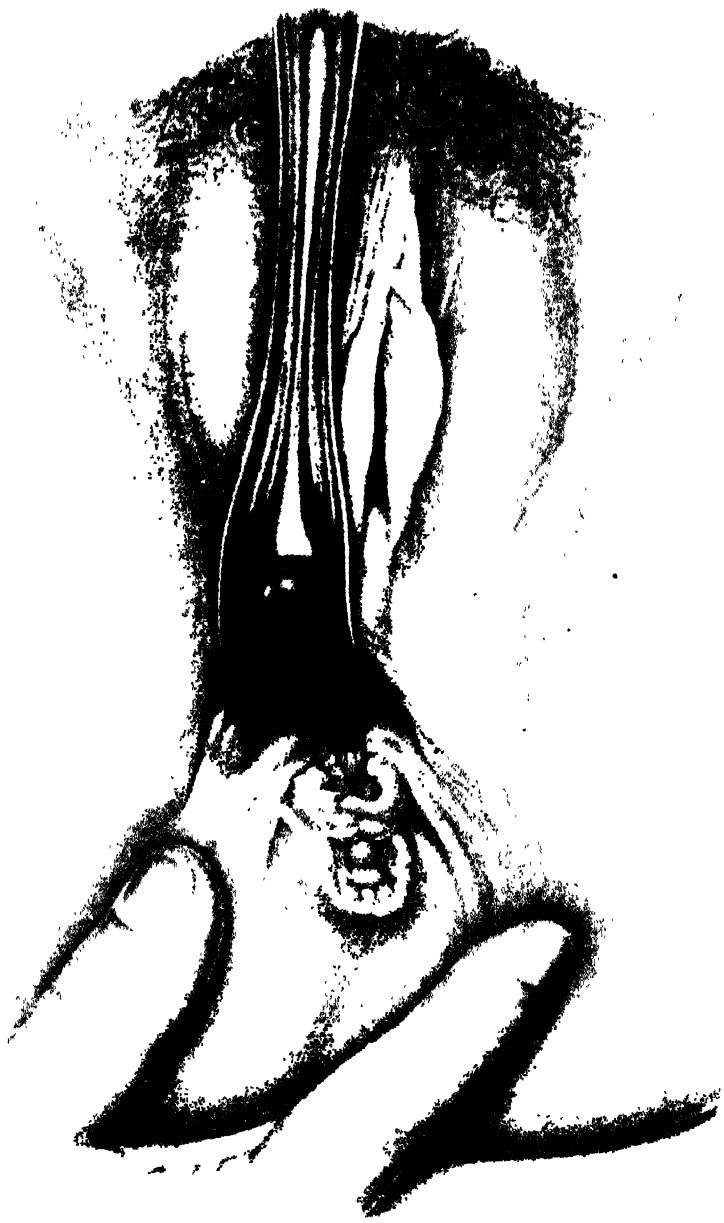
Inflammation of the cellular tissue around the rectum is generally due to extension by infection of a disorder of the rectum, such as hemorrhoids, fistula, fissure, cancer, etc., or to a local traumatism by hardened feces, a foreign body, a piece of bone or fishbone ingested with the food, etc., or again to extension of an inflammatory process from neighboring tissues, the urethra, bladder, prostate, vagina, uterus, ovaries, etc.

Periproctitis may be *circumscribed*, an abscess forming first beneath the mucosa or the skin of the anus; either of these may open spontaneously and form a sinus. Or it may be *diffuse*, the inflammatory process involving a large area through rapid spreading, thus leading to extensive sloughing. Such a process is usually observed in weak and aged subjects and often ends in death.

An **ischiorectal abscess**, acute or chronic, may result from periproctitis. The acute form gives rise to pain, heat, swelling and redness, with brawny induration of the affected side of the anus. Chronic ischio-rectal abscesses are usually tuberculous.

These are painless until pyogenic germs start an acute abscess, which then gives rise to the symptoms of that disorder.

TREATMENT.—Circumscribed abscess when superficial may be treated by **incision and drainage**. In the diffuse form, the strength of the patient must in every way be sustained by tonics, especially *strychnine*, iron, and nourishing food. The abscess may then be treated by free



Gonorrheal Abscess. Caused by Infection of Vaginal Origin.

drainage and stimulation with **silver nitrate**. If the area is not too extensive, **bismuth paste** may be used. In acute ischiorectal abscess a **free incision** should be made and the cavity washed out freely with **creolin solution**, followed by **iodoform packing**. The same treatment is indicated in the chronic form.

STRICTURE OR STENOSIS OF THE RECTUM.

Stricture of the rectum may be caused by tumors of the neighboring structures or perirectal abscesses, wounds or ulcers of the rectum. Muscular spasm may cause temporary stricture. Sometimes a stricture is a congenital deformity. There are circumrectal strictures, caused by very fine adhesions or plastic bands in Douglas's *cul-de-sac*, which are postoperative in women. They may follow improperly performed operations for hemorrhoids, Whitehead's ligature, or excision. Amebic dysentery may be a cause, also syphilis, although systemic treatment is of no avail. Gonorrhea is believed to be the cause by some; tuberculosis is a prominent factor. Strictures may be valvular, annular, and tubular, all of which can ultimately so obstruct the intestine as virtually to arrest its functions as a canal.

The symptoms are at first those of constipation which becomes increasingly worse, the stools assuming the shape of ribbons or pipe-stems, according to the kind of stricture present. The intestine is dilated above the stricture; this may lead to the formation of a fistula. Examination of the rectum should be insisted upon; this may readily be done by means of the speculum and finger.

The pouch above the stricture is caused by the accumulation of feces which is evacuated by periodical attacks of diarrhea or enteritis; in some cases complete obstruction is caused. The stricture is sometimes the seat of pain and ulceration, and mucus, pus, or blood may be passed.

TREATMENT.—Gradual dilatation of the stricture with bougies, and the frequent irrigation of the rectum or **enemas** to evacuate retained feces are efficient measures in mild cases. In suitable cases **resection** of the stricture should be practised. In severe cases **colostomy** is indicated; where the stricture is long and tubular, an **artificial anus** becomes necessary. The general weakness of the patient should be taken into account in these cases, and the ease with which the rectal wall is torn and the possibility of causing infiltration and abscess should not be overlooked. According to some, **diathermy** gives better results than any other form of treatment.

TUMORS OF THE RECTUM AND ANUS.

BENIGN TUMORS.—The benign tumors are new growths whose cells are arranged in the same systemic order as the tissues from which they originate, with no special function and with a tendency to grow away from the parent tissue. Most of them arise from the mucous membrane or from the anal skin and are therefore epithelial in character. Sometimes they are of congenital origin, such as tumors arising from abnormalities of the mesenteric canal and dermoid cysts.

Adenomata, or soft polypi, are probably the most frequent form of

the benign neoplasms met with in the rectum. They occur with the same relative frequency in both of the sexes and especially between the ages of 3 and 12. They vary in size from that of a small pea to that of a large chestnut, although cases are on record in which the tumor has been considerably larger. Their shape is more or less globular or pyriform. The surface is usually lobulated and nutmeg-like. It is attached to the rectal wall by a narrow, but often elongated, pedicle. Arterial pulsation can frequently be felt within the pedicle, as it is through this stem that the blood-supply of the growth is furnished. The vessels conveying the same are often of fair size. This fact is of importance, as it may account for the excessive bleeding which occurs in spontaneous detachment of such tumors.

These tumors are sometimes multiple, involving the entire rectal mucosa or scattered about the intestinal wall. I have seen several such cases.

These growths closely imitate the normal mucous membrane in structure, though their glands are larger, more abundant, more branched and convoluted, and less irregularly disposed. They also ascribe their greater frequency in the rectum than elsewhere to the fact that this portion of the intestinal tract is more liable to irritation.

Fibromata.—These tumors take their origin from the submucous or connective tissue of the bowel, are more or less pedunculated, and vary with regard to their relative firmness. All of the very dense fibrous polypi that have been met with have been as large as an English walnut; they creak when cut, and the incised sur-

face is of a pale color. Such growths are considered quite exceptional specimens of this form of tumor. The small polypi so frequently seen in connection with fissure and with hemorrhoids are due to an hypertrophy of the upper extremities of the columns of Morgagni. Unstriped muscular tissue is sometimes found intermixed with the fibrous tissue of these growths, and, according to Cooper and Edwards, it may form the greater portion of the tumor. Usually these tumors are single, but occasionally they are multiple, and, in rarer instances, disseminated over quite an extensive area of the bowel. The surface of these growths is usually smooth, and they are apt to be pear-shaped.

Papillomata.—These growths are variously termed by different authorities as "villous tumors of the rectum," "villous polypus," and "granular papilloma." According to Ball, they are a rare form of rectal growth, resembling the villous tumor of the bladder in general appearances, with the slight difference, however, that the lobes in the growth occurring in the bladder are more filiform, while in the rectum they are flattened or club-shaped. They are composed of the papillæ of the mucous membrane, which have proliferated freely, and are covered with cylindrical-celled epithelium. Papillomata are attached to the wall of the bowel by a more or less broad pedicle, but they are occasionally sessile. They bleed freely and occasion more or less mucoid discharge. They may protrude from the anus.

Lipomata.—Tumors composed of adipose tissue have also been observed in the rectum.

Teratomata, or dermoid cysts, are very seldom found in this situation. They differ in no respect from the same growth as found elsewhere in the system.

Enchondromata, or cartilaginous growths, are said to occur in the rectum, but they must be extremely rare.

Angiomata.—These nevoid tumors are likewise of rare occurrence in the rectum, and when they exist may occasion considerable hemorrhage.

Cystomata.—Various cystic tumors may occur about or within the rectum, but dermoid cyst is the most authenticated variety found in this locality.

New Growths Arising from Parasites.—P. Lockhart-Mummery of London, Eng., calls attention to an infection of the rectum by certain parasites which give rise to outgrowths of the mucous membrane of an adenomatous character, and cites that the best known example of this condition is to be found in the multiple adenomata of the rectum produced by the ova of *Bilharzia hematobia*, which appears to occur only in Egypt as a result of bathing.

This same authority mentions a case of rectal tumor produced by *Oxyuris vermicularis*, and reported by Ruffar.

Angiomata.—Nevoid growths about the rectum differ in no particular from similar affections elsewhere except that they may ulcerate more readily, which is due to the bowel actions producing more or less irritation.

Angiomata may occasion severe hemorrhage. Such growths are rare and, when present, are often congenital.

SYMPTOMS.—There are no marked symptoms to be defined as peculiar to benign growths. A sensation of weight in the rectum may be experienced; shooting pains, distress in the loins or back, more or less tenesmus, and diarrhea, with more or less discharge of mucus and of blood, are often noted. The character and intensity of the symptoms are influenced by the size and position of the growth. If situated high in the rectum, but little, if any, inconvenience may be experienced. When, however, it is attached low in the bowel, the local discomfort is complained of.

The differential diagnosis of the varieties of rectal tumors has already been sufficiently dwelt upon. Piles are not pedunculated, and a prolapse should occasion no difficulty in diagnosis. In cases of polypoid growth an enema should be administered and the entire rectum examined by first passing the examining finger as high as possible into it, then sweeping the palmar surface around the mucous membrane from above downward. In this manner the polypus may be caught between the finger and the rectal wall if present. Otherwise the growth would escape detection by being pushed ahead of the examiner's finger.

Tumors of the rectum, especially when situated some distance up, may occasion intussusception and even prolapse of the bowel. Partial and even complete obstruction of the bowel may likewise be caused. Ulceration and extensive bleeding may also be produced.

TREATMENT.—The treatment of these tumors is essentially surgical. Prompt removal is the only safe ad-

vice to give, the actual cautery or the ligature being employed. Anesthesia may be required in some forms of this trouble before operative interference may be carried out. Small polypi may, with comparative safety, be twisted off with a pair of hemostatic forceps.

MALIGNANT GROWTHS OF THE RECTUM.

The rectum is one of the favorite sites for malignant growths. In this region, as elsewhere, cancer is viewed as a seldom curable affection, and is stated to run its course in about two years. It usually occurs after middle life, though cases are recorded in which it attacked the very young, and, though believed to be more frequent among females, Messrs. Allingham state that in their experience many more men are victims to this disease, to which statement my experience would seem to lend emphasis.

VARIETIES.—The forms of malignant disease met with in this locality are: (a) epithelioma, (b) scirrhus, (c) various forms of sarcoma, (d) encephaloid, (e) colloid, and (f) melanotic. In those tumors in which much fibrous tissue is mixed with the newly formed glandular structures, the growth is hard and resistant; when the neoplastic tubules are in excess, and the fibrous tissue delicate and scanty, the tumor is soft and fungous, and corresponds with the description of medullary cancer. A gelatinous condition due to mucoid or colloid change affecting the cells has given rise to the term "colloid" as applied to such growths.

The three terms scirrhous, medullary, and colloid signify varying

conditions of a growth or parts of a growth composed essentially of glandular tubules and epithelial cells.

Cooper and Edwards subdivide the adenocarcinoma into three forms, which may be severally distinguished as (a) the *laminar*, (b) the *tuberous*, and (c) the *annular*. Their description of these varieties is as follows:—

"In the *laminar* form, which is the most common, a portion of the intestinal wall is infiltrated or thickened, the affected area varying in size according to the stage of the disease. The thickening appears to exist between the muscular and mucous coats, and it tends to spread laterally rather than either upward or downward. Its center is slightly raised, while the edges are beveled off. The growth is connected with and binds together all the tissues of the bowel, but at first is freely movable as a whole. After awhile the surface of the neoplasm gives way, leaving a ragged ulcer with characteristically infiltrated borders. The destruction generally begins near the center and extends toward the circumference; but sometimes ulcers form at several points on the surface. As the process advances, the infiltration is gradually eaten away; its remains may be recognized as nodules or papillary excrescences rising from the base or border of the ulcer. In later stages the base may be smooth, hard, and clean, being formed by cicatricial tissue and the remains of the muscular coat, while the edges are hard and raised, and either tolerably uniform or beset with nodular or papillary growths. Much connective tissue is developed beneath the base of the ulcer, and becomes constricted and puckered, as these changes are in

progress. The course of the growth is sometimes different, inasmuch as the deposit is only partially destroyed by the ulceration, and its remains sprout up and form tumors projecting into the cavity of the bowel. The ulceration sometimes has another result, viz., destruction of the coats of the bowel and perforation of adjoining viscera.

"In the *tubercous* form the growth projects into the bowel. Its consistence varies, being sometimes hard and firm and in other instances soft and fungoid. One such mass may be present; or there may be several growths of the same character, but varying in size. At first the mucous membrane, though firmly adherent to the tumor, remains intact, but is soon destroyed by ulceration, and a portion of the growth is then apt to project through the opening thus made. Sometimes the membrane gives way at several spots, at which nodules or larger portions protrude. Such outgrowths are soft and friable. Sometimes the destructive process is too rapid for the development of fungoid growths; when the surface gives way, the ulceration continues to extend deeply and superficially until the muscular coat is laid bare. The cancerous process invades the neighboring tissues and structures,—*e.g.*, bladder, urethra, or vagina,—and openings are made into these parts. The process again may extend toward the sacrum and involve the nerves and bones of the pelvis. Occlusion of the bowel by a fungoid mass is a less frequent result.

"In the *annular* form the growth begins as a deposit between the mucous and muscular coats, and extends laterally so as to involve the whole

circumference of the bowel, but does not spread upward to any great extent. The subsequent contraction diminishes the caliber of the bowel and causes a marked degree of stricture."

SYMPTOMS.—The early symptoms of cancer of the rectum are far from being characteristic. Indeed, it often exists for a considerable period before the patient is cognizant of any trouble. Frequently patients consult a surgeon about hemorrhoids or some minor affection of the rectum or anus, and it is only after a digital examination that the presence of cancer is recognized. Generally, the first sign experienced, in cases of this disease, is a sensation of uneasiness in the lower part of the back and along the inner sides of the thighs, with possibly a similar feeling within the rectum. At the end of a day's work this may be supplanted by actual pain of a dull, heavy character. The next and most usual symptom is morning diarrhea. As soon as the patient gets out of bed, or soon thereafter, he is obliged to go to the closet. He may or may not pass any fecal matter, but does pass a thin, sanious discharge, having a most characteristic odor. Later the bowels move several times during the morning and most of the stools consist of this sanious discharge. The color of the stools is such that most patients ascribe their trouble to piles, and the discharge is attributed to blood from the latter. Constipation may alternate with the attacks of diarrhea.

Pain is nearly always a very late symptom of cancer of the bowel; this depends, however, upon the rapidity of the growth of the neoplasm. As soon as the growth invades the anal

portion, or neighboring organs, or involves the sacral nerves, pain becomes a marked factor. Obstruction of the bowel and the straining efforts at defecation will tend to increase the pain.

The discharge varies in quantity in different cases and at various stages of the development of the growth. In the early stages the blood is probably brighter in color and is derived from the congested vessels in the neighborhood of the tumor, but later on the hemorrhage is due to ulceration and erosion, as well as to congestion. In some cases the constitutional effects are most marked. In nearly all cases there is loss of flesh and strength, but this occurs, in my experience, only in the late stages. Often the cancerous cachexia is not sufficiently marked, in the early stages, to be very noticeable. In the late stages the liver is often enlarged. The lumbar and pelvic glands are usually involved, although this condition may not be so marked as to be readily distinguishable.

The duration of the symptoms varies in different cases and depends, to some extent, upon the age of the patient and the character of the neoplasm. In the young, the disease generally runs its course quite rapidly, and when the growth is soft its effects are more rapid.

DIAGNOSIS.—There are two conditions which are likely to be confounded with malignant disease of the rectum, one being local benign growths, and the other, neoplasms external to the bowel.

Benign growths are generally pedunculated, cancers rarely so; benign growths, unless ulcerated, are bathed

in healthy, transparent mucus; cancers discharge offensive, chocolate-colored matter, the odor of the same being almost pathognomonic of malignant disease. Benign tumors are not friable, like malignant growths, nor do they bleed as easily.

Benign neoplasms spring from a soft, healthy mucous membrane, which glides freely upon the deeper coats of the bowel, while the malignant tumor grows from an indurated lump or patch in the bowel, which seems fixed or rigid. In suspected tumors, in which the diagnosis is at all obscured, a small specimen of the same should be obtained by scraping the tumor either with the finger-nail or a curette, and subjected to a microscopic examination.

Digital palpation, alone or combined with proctoscopy and sigmoidoscopy, is the chief measure in diagnosis, since none of the serum or other tests have so far proved reliable. In 1428 out of 1670 cases, the cancerous tumor was within reach of the examining finger. J. R. Pennington (*Jour. Amer. Med. Assoc.*, Nov. 25, 1922).

In high-situated cancers dilatation of the rectal ampulla with gas is a frequent, though not pathognomonic, finding. Examination of the mobility of the tumor during contraction of the abdominal muscles is important. F. Mandl (*Deut. Zeit. f. Chir.*, Feb., 1922).

Digital examination of the rectum urged for indefinite abdominal, sacral, bladder, or sciatic pains even in the third decade of life, in which the cancer symptoms are especially likely to be misinterpreted. Absence of visible or occult blood does not exclude cancer. In obstinate bowel irregularity the rectum should be examined repeatedly. Even if a growth is palpable, X-ray examination should not be omitted. Kuttner (*Med. Klin.*, Sept. 17, 1922).

In 110 cases of carcinoma of the rectum or rectosigmoid, the onset was

gradual in 77 and sudden in 33. The 1st symptom was constipation in 68, bleeding or cancer diarrhea in 37, and pain in 5. An unaccountable attack of obstinate constipation; a desire to go to stool in the morning on arising, with no result or only the passage of flatus and a little mucus, probably blood-streaked; an abnormal rectal discharge, and a vague, ill-defined feeling that something is radically wrong in the lower abdomen, or a feeling of obstruction in the rectum, form a symptom-complex that is present in nearly every case of beginning cancer. In this series the tumor was palpable in 99 cases, so that in only 10 per cent. of cases was the proctoscope essential to determine the presence of a growth at a higher level. The ratio of operable cases was 61 per cent. F. C. Yeomans (Med. Jour. and Rec., May 21, 1924).

PROGNOSIS.—The duration of the symptoms will prove of value in reaching a conclusion, the onset and progress of benign neoplasms being extremely slow. In malignant disease there is usually a portion of tolerably healthy mucous membrane between the growth and the anus, whereas in the non-malignant stricture this portion of the bowel is generally more or less infiltrated (Cripps).

TREATMENT.—If it were possible to recognize the existence of cancer at its earliest stages and to obtain consent for its radical removal, the prognosis of such operations would be greatly bettered, and the statistics would show, at least, a remarkable prolongation of life. Great relief from the most distressing symptoms would also be afforded.

It is frequently a hard matter to decide which of the surgical procedures is to be resorted to, the aim being to afford the greatest relief with the incurrence of the minimum risk.

The recognized procedures are 3 in number: *Extirpation*; *colostomy*, inguinal and lumbar, and *curettage*.

Extirpation.—*Kraske's operation* is as follows: The patient being placed on his left side, an incision is made starting from the second piece of the sacrum and extending down to the anus, in the middle line. The soft tissues are then carefully raised from the sacrum, the coccyx is excised, and the sacrosciatic ligaments are severed at the sacrum. The rectum is thus brought into the field of operation. If it is necessary to increase the field, a portion of the left side of the sacrum opposite the third sacral foramen may be removed. Kraske does not favor sacral section above this level, nor does he recognize the utility of a temporary or osteoplastic resection, which some advocate with a view to prevent prolapse of the pelvic organs, owing to a presumed weakening of the floor of the pelvis. The resection of the cancer is begun by him with the division of the bowel below the tumor by opening it transversely; sutures are then placed in the upper cut surface for traction purposes. The patient is next brought into the lithotomy position, and the dissection proceeded with. Sometimes the peritoneum can be peeled off the bowel; but, if necessary, it must be opened, two fingers introduced, the gut pulled down, and the operation proceeded with. Packing of the wound with iodoform gauze should be adopted to prevent infection, and need not be removed till it shows a tendency to become loose, after about a week.

Aside from Kraske's operation by the sacral route, various other procedures are carried out, by different routes, according to indications. In the *perineal operation*, some-

times employed in tumors of the lower two or three inches of the rectum, a circular perianal incision is made, followed by a straight incision to the tip of the coccyx and scrotal junction, the rectum freed from its attachments and drawn out of the wound, amputated above the growth, and the cut end sutured at the anal site. While in some cases the external sphincter can be preserved, in most instances it cannot, and there results the serious inconvenience of fecal incontinence; this method is also less certain as regards the removal of involved lymph-nodes than some other procedures.

The *vaginal operation* is available in females where there is a small growth on the anterior rectal wall. The posterior vaginal wall is split, the tumor excised, and the rectum and vagina sutured.

The *abdominal type of operation*, fundamentally requisite in growths located too high to be removed by other routes, has the advantages of permitting better determination of the presence of metastasis and of better subserving thorough removal of diseased tissues. It may be either *abdominoanal*, *abdominoperineal*, or *abdominosacral* ("combined" methods), according to indications. Again, fecal evacuation may be provided for either by an inguinal colostomy or by joining the cut ends of the bowel, according to the conditions found. In *Weir's operation* (abdominoanal), after opening of the abdomen, the bowel is divided below the tumor between two tapes tied around it; the upper segment, containing the tumor, is then brought up through the abdominal wound and the growth removed; next, the upper end of the lower segment is invaginated and pulled out through the anus, and the upper segment drawn through it and sutured.

Present surgical opinion is veering toward a permanent **colostomy**, to be followed at once or later by **extirpation** of the entire bowel distal to the colostomy and a complete dissection of the pelvis. No single type of operation is suitable for every case. The ideal procedure is a one-stage **abdominoperineal extirpation**, an enteroanastomosis being performed by the Balfour or other method, or the sigmoid drawn through the anus and fixed there. L. Kuttner (*Med. Klin.*, Sept. 17, 1922).

The writer takes exception to the view that a permanent abdominal artificial anus must be established as a routine measure and the entire sphincter apparatus always sacrificed. Reporting on 800 cases of the **conservative sacral operation**, he states there were 36 per cent. of cures extending over 3 years or more, and 24 per cent. extending over 5 years; 52.9 per cent. of these patients secured complete and 17.6 per cent. almost complete continence. H. Küttner (*Zent. f. Chir.*, May 24, 1924).

In rectal cancer in general, the writer sometimes uses the **combined method**, and more often the **perineal**, with removal of the coccyx and the last segment of the sacrum, a thorough exploration and a **colostomy** opening having been made some days previously. Maunsell (*Brit. Med. Jour.*, May 2, 1925).

Colostomy.—Colostomy as a separate procedure is of value in a large number of instances. The benefits derived from its performance have been thus minutely described by Kelsey: "It relieves pain; does away with the constant tenesmus and discharge from the rectum, which by their exhausting effects are the immediate cause of death; delays the development of the disease by preventing the straining and congestion of defecation; prevents absolutely the complication of intestinal obstruction, which is another cause of death; enables the patient to sleep, eat, and gain flesh, and often makes him think himself cured in spite of the plainest prognosis to the contrary. Instead of his passing his days and nights upon the commode, wearing out his life in his efforts to free the bowel from its irritation, he has one or perhaps two solid fecal evacuations from the groin in twenty-four hours." Colostomy is the operative

procedure indicated when a cancer has passed beyond the time when the surgeon reasonably expects an extirpation to afford a radical cure.

In all cases unsuitable for radical removal, **colostomy** should be performed to relieve pain in defecation. Fixation of the growth is diminished by this procedure. Among 277 cases of **sacral operative removal** with sacral anus, the mortality was 14.1 per cent. With this method 30.5 per cent. could be considered cured after 3 years, 25 per cent. after 5 years, and 10 per cent. after 10 years. There were 205 **resections** performed, with a mortality of 8.78 per cent., *i.e.*, less than where the sphincter was sacrificed. The permanent results after resection were 37 per cent. after 3 years. F. Mandl (*Deut. Zeit. f. Chir.*, Feb., 1922).

Curettage.—In those cases in which the growth is within the lower three inches of the rectum and its character is such that extirpation is not possible, and colostomy is not at the time necessary and the growth not hard, considerable temporary benefit may be given the patient by resorting to this operation. In selected cases it is followed by a diminution of pain, bearing-down sensations, and discharge, and the lumen of the bowel is enlarged.

In certain cases the combined operations of colostomy and of curettage will afford the patient much more relief than where one or the other procedure is individually adopted.

Röntgen Rays and Radium.—These agencies are utilized by some as an auxiliary to surgical procedures and also for palliative purposes in inoperable cases. There is as yet no unanimity of opinion as to the indications for the employment of these two types of irradiation.

Description of a method of inserting **radium needles** into the upper part of

the rectal growth after a lower left rectus or inguinal **colostomy** has been performed under local or spinal anesthesia. An operating cystoscope is introduced into the rectum through the colostomy opening, a special telescope instrument holding a radium needle passed through it, and several needles, with attached silk cords, inserted into the growth, the distal portion of which is also treated with radium, properly screened, introduced with a rubber applicator through the anus. J. O. Bower (*Surg., Gyn. and Obst.*, Apr., 1922).

Striking benefit from **radium and deep X-ray therapy** witnessed in some cases; others were temporarily improved so that an artificial anus could be dispensed with; still others were unchanged, while among the inoperable cases some showed a rapid decline following the treatment. Kuttner (*Med. Klin.*, Sept. 17, 1922).

Two inoperable cases in which, after colostomy, vigorous **radium and X-ray treatment** so reduced the growths that the patients were enabled to return to work and have remained free of disturbances for 5 and 6 years. Gaarenstroom (*Ned. Tijds. v. Gen.*, Nov. 11, 1922).

Radium used alone or with some operative procedure is the most valuable therapeutic agent in rectal cancer in all its stages. In a group of 94 cases, 90 of which were inoperable, radium treatment without operation cured 8.5 per cent of cases and afforded improvement for 6 months to over 2 years in 65.9 per cent. Of 58 cases treated by radium plus operation, comprising 33 cases recurrent after operation elsewhere, 16 cases of extensive involvement, and 5 cases apparently hopeless, 17.5 per cent. were cured and 50.5 per cent. improved. In hopeless cases radium is valuable in giving relief to various symptoms and affording comfort for the remainder of life. A number of cases (27 per cent.) do not respond to radium, *i.e.*, are "not radio-sensitive." Trial of radium is, however, justified in every case. In operable cases there is little choice as to whether radiation or operation should

be done first. In inoperable or borderline cases both external and internal radiation, with radium implantation, are advised in the hope of bringing the tumor to an operable size or causing it to disappear. H. A. Kelly and J. E. Ward (*Surg., Gyn. and Obst.*, Nov., 1923).

Radium, properly applied, brings about a definite inhibitory and destructive effect in the majority of rectal neoplasms. It is a valuable adjunct to surgical procedures. In selected cases radiation should be used before and after operation. **Deep Röntgen therapy** should also be given in the pelvis with the hope, first, of destroying or decreasing the amount of lymphatic tissue and thus reducing the opportunity for metastasis, and second, of destroying or inhibiting metastatic nodules. A. W. Jacobs (*Surg., Gyn. and Obst.*, July, 1926).

Medical treatment of cancer of the rectum presents but three points for consideration: The **daily evacuation** of the bowels, the use of some soothing **local antiseptic wash** to cleanse the parts, and the relief of pain and tenesmus. The first indication may be met by the employment of salines: **Citrate of magnesia**, **magnesium sulphate**, or **sodium phosphate**; the second, by enemata of a 2 per cent. **solution of creolin**, or the same strength **solution of potassium permanganate**. The third indication for a time may be overcome by the use of **iodoform suppositories** (10 grains of the drug in each suppository, used, if necessary, every six hours). The use of opium should be avoided as long as possible.

LEWIS H. ADLER, JR.,
Philadelphia.

REFRIGERATION.—Refrigeration, or thermosteresis, is the process of abstracting heat, or of making or keeping cool; when carried to its

limit, congelation or freezing ensues. The milder degrees are produced through the action of water of varying degrees of low temperature, applied in various ways: Evaporating lotions containing some medicinal agents, ice-bags or ice-caps, the mineral acids, etc. These milder degrees of refrigeration will be found treated under their appropriate heads and need not be considered here.

In the more intense forms of refrigeration—congelation or freezing—we may make use of volatile liquids like ether, ethyl chloride, rhigolene, etc., or of carbon-dioxide snow or liquid air. The use of the volatile liquids as refrigerants will be found under each remedy named, and it only remains to consider the uses of liquid air and carbon-dioxide snow.

PHYSIOLOGICAL EFFECTS OF COLD.—The application of cold to the living body causes congestion of the superficial capillaries and, later, their rapid and extreme contraction, with a lowering of the surface temperature. A moderate degree of exposure is followed by a reaction during which the capillaries become dilated, the circulation stronger, and normal body temperature restored. In weak or debilitated persons the reaction is either delayed or absent; generally there is a longer period of vital depression, attended by subnormal nutrition and followed by slow recovery.

Prolonged exposure to a low temperature may be followed not only by local and temporary vascular syncope, but local and even general devitalization; beyond this only the physical and chemical effects of cold obtain. Complete restoration of function never follows complete freez-

ing of a tissue or organ; the devitalized portion becomes necrosed and sloughs off, as in frost-bite and gangrene. When the cold is less intense, permanent dilatation of the capillaries is apt to follow, associated with paresthesia and, perhaps, pruritus, as in pernio, or chilblain.

Continued exposure of the body to intense cold causes a shriveling and lividity of the skin, muscular weakness and rigidity, mental symptoms, drowsiness, confusion, coma, and, finally, death. These effects have been mistaken for those of alcohol, and the error is more easily made if the person has been indulging in alcohol previous to his exposure.

PATHOLOGY OF COLD.—The pathological appearances of general exposure to cold are: a waxy anemia of the surface with bright-red patches on the more exposed parts of the body. There is marked congestion of the internal organs, and reddish-brown stains are found along the course of the superficial blood-vessels, due to disintegration of the blood-cells and diffusion of the coloring matter through the vascular walls.

Local freezing causes an occlusion of the blood-vessels with subsequent anemia, necrosis, and atrophy of the epithelium in proportion to the intensity of the application (Bowen and Towle).

LIQUID AIR.—Liquid air was first made in appreciable amount by Dewar, of England, in 1877. A. Campbell White, the first to use it as a therapeutic measure, published the first report of his work in 1899. In the preparation of liquid air the atmospheric air is first dried and purified by chemical filtration, and then liquefied by repeated compres-

sions (at first 100 pounds, then 800 pounds, and, finally, at a pressure of 2000 pounds to the square inch) and a cooling device.

Liquid air looks like water and can be poured like it. It feels like water when the finger is thrust into it and hastily withdrawn; the finger, however, comes out dry. When it is poured on the floor, it strikes with considerable noise and at once vanishes as steam without wetting the floor. Seen through its glass container, it appears to be gently simmering, and a delicate vapor floats over the mouth of the flask. The temperature of liquid air is -422.5° F. (-252.5° C.). It cannot be corked up as, in its effort to resume its natural state as atmospheric air, it develops such great expansive power that nothing but the strongest steel cylinder could be used. It is marketed in what is called a "Dewar bulb," a flask so blown that one flask is inside another with a vacuum between. This flask is placed inside a case, and closely surrounded with wool to prevent too rapid evaporation. The mouth of the flask is partially stopped with a loose plug of absorbent cotton, so as to allow the escape of the small amount of vapor that is constantly arising from the liquid. A liter (quart) of liquid air may, in this way, be kept for several days.

Method of Application.—Liquid air is applied by means of pledgets of absorbent cotton wrapped around wooden applicators. These pledgets may be of any size or shape, but sufficient cotton must be used that they will absorb enough liquid to produce the desired effect. In very small lesions a larger surface than

would otherwise be necessary must be frozen, because very small pledgets would not hold enough liquid. The pledget is dipped into the liquid air, withdrawn, given a sharp shake to remove the excess of liquid, and is then applied to the affected part with pressure sufficient to produce the desired effect.

CARBON-DIOXIDE SNOW.—

Carbon dioxide, or carbonic acid gas, is manufactured extensively, for charging soda-water fountains, by the action of sulphuric or hydrochloric acid on calcium carbonate (marble-dust), and is purified by passing it through a solution of potassium permanganate. The gas is liquefied under pressure (900 pounds to the square inch) with a cooling device similar to that used in liquefying air. As the liquefied gas is under less pressure, it is safely delivered in steel cylinders. When the liquid gas is allowed to escape its temperature falls to -23.8° F. (-31° C.). By mixing it with ether and allowing the mixture to evaporate, the temperature may be lowered to -148° F. (-100° C.). Dr. W. A. Pusey, of Chicago, was the first, in 1905, to suggest the possibilities of liquid carbon-dioxide gas as a substitute for liquid air; the idea and technique were further elaborated by S. Dana Hubbard and George Thomas Jackson, of New York, and others.

Method of Application.—To make snow for freezing purposes the cylinder holding the gas must be placed on a stand, or fastened to a wall bracket, and inclined at an angle of about 45 degrees to prevent the freezing of the escape valve; this position also favors the making of a soft and easily molded mass of snow. The

valve end of the cylinder should be firmly fastened by a strap, as, occasionally, the valve is hard to turn. The cap covering the vent-hole is removed and the snow may now be made. When a portion of the liquid carbon dioxide is allowed to escape, a part resumes its original form of gas or vapor, and the remainder is frozen, or converted into snow, by the intense cold produced by the rapid change of state of the carbon dioxide from a liquid to a vapor, according to the well-known laws of latent heat; the snow may be caught and retained by some porous material wrapped around the vent, through which the vapor can pass. Carbon-dioxide snow is, therefore, simply frozen or solidified carbon dioxide.

To gather the snow Pusey first used a chamois bag made by taking a piece of chamois skin, making several turns with the straight edge about the hole, and then folding the piece back on itself. Kimball, of Boston, uses a chamois cylinder about two inches in diameter by eight inches long, with tapes at one end and open at the other. This can be rolled up, and any quantity of snow can be collected in it. Blotting-paper, without glazing, rolled up in a tube may be used, the end being lightly stopped with absorbent cotton. Hubbard, of New York, uses a length of brass pipe, large enough in diameter to fit around the vent-hole, cut longitudinally in two parts, joined on one side with a piano hinge, perforated with a number of holes, and covered with chamois skin on both surfaces. The chamois is two or three inches longer than the tube so that it may be turned back over the latter. Hubbard has obtained the

best result by wrapping a little absorbent cotton about the vent-hole, and placing a plug of cotton in the farther end of the tube before applying it to the vent-hole.

When one is ready to make the snow the chamois bag or the Hubbard apparatus is applied to the vent-hole and the gas is allowed to escape by turning the nipple at the extreme end of the cylinder with the small wrench that comes with it. The gas is allowed to escape, first slowly and then more rapidly. A sound as of gas escaping under pressure is first heard. Some sputtering and jerking of the bag or tube may occur, but need occasion no alarm. Then a bluish gas will appear and in five or ten seconds fine snowflakes will blow through the chamois, showing that the apparatus is full of snow. The gas is then turned off and the apparatus removed. The snow may now be molded in any shape by working it in the bag, or packing it in sections of iron or brass pipes of various diameters. Ear specula make good molds for small lesions. The use of square-shaped molds is advised by Pusey, so that if more than one area is to be frozen the edges may not overlap. The temperature of the snow is -108.4° F. (-78° C.), yet it can be safely handled and molded if the fingers are protected by the chamois or by a glove. Snow prepared in the Hubbard apparatus is compact, and can be pared with a knife to any size or shape. When drawing the gas it is best to wrap a towel around the apparatus to further protect the hands. A crayon of carbon-dioxide snow can be held in the palm of the hand for several seconds without freezing the tissues, owing

to the formation of a layer of carbon-dioxide gas (Crook's layer) between the snow and the skin. Apply pressure and freezing begins at once.

EFFECTS OF FREEZING.—The effect on the tissues is the same whether liquid air or carbon-dioxide snow is used, save that, as the air is more than three times as cold, the effect is more rapidly produced. The snow should not be mixed with ether, as suggested by the Mayo brothers, or chloroform, but the cone should be lightly dipped into it just previous to applying it to the skin (Hubbard and George T. Jackson).

When the snow crayon is placed on the skin, with slight pressure, there is a sizzling sound and the area of contact is at once frozen hard, turns white, and when tapped with a pencil emits a sound like that produced by striking a board. The amount of pressure used and the duration of contact will determine the depth of the freezing. A superficial lesion will require light pressure and short contact. With moderately firm pressure the part will be frozen stiff in ten seconds. After a few minutes the part will thaw, a zone of redness will encircle it, and presently vesicles will appear on it. A slight crust will form in a day or two, which on separating will leave a faint, soft scar. This may entirely disappear. With firmer pressure the parts will be frozen deeper in thirty seconds. Thawing will be slower, and a tense bulla will appear in from six to eight hours, which will, later, shrink and become a dry crust leaving a slight scar. The crust is always dry and the scar soft and pliable after either liquid air or carbon-dioxide snow. When dipped into

ether or chloroform the duration of contact must be less, as the effect is increased. Remove all crusts before freezing; cover mucous surfaces with a layer of gauze to prevent the cotton pledget from freezing fast, when liquid air is used. Bullæ may be pricked, but crusts must not be removed. Freezing should not be repeated, if necessary, until the effects of the first freezing are fully recovered from.

RELATIVE VALUE OF AIR AND SNOW.—If liquid air could always be obtained it would be preferred because of the ease of its application, the rapidity of its action, and its comparative painlessness. The uncertainty of the supply and its high cost make the use of liquid air almost prohibitive.

The advantages of carbon-dioxide snow are: It can be easily obtained; a cylinder can be kept in one's office, or the snow can be made in any drug-store where the soda-water is charged on the premises; it can be used on small lesions, as, unlike liquid air, no larger surface than is necessary need be frozen, as the mass or crayon of snow may be pared down to any size.

THERAPEUTIC USES.—Pusey gives three indications for the use of carbon-dioxide snow: (1) to produce a simple inflammatory reaction; (2) to produce destruction of certain tissues by interstitial scar-tissue formation; (3) to produce immediate destruction of tissues by freezing. He emphasizes the fact that its usefulness lies chiefly in the fact that an interstitial sclerosis of the tissues (scar-tissue formation) can be produced by it, without destroying all of the tissues in the area treated.

While freezing is for the most part

used as a destructive agent, liquid air may be used to stimulate **ulcers**, as suggested by White, and for producing **local anesthesia**. For the latter use it acts more promptly than ethyl chloride and a superficial freezing is sufficient. This anesthetic action is available to relieve the pain of **herpes zoster**, in which case the cold is applied to the spine. In the treatment of **boils** and **carbuncles** White applied the liquid air in the form of a spray from a bottle with a cork perforated to receive two glass tubes of unequal length. The finger placed on the shorter tube, air comes in a fine spray from the other tube that dips below the surface of the liquid and has the other end bent downward at an angle, the air being forced into the openings of the carbuncle or boil, and the surface being slightly frozen.

In affections of the skin carbon-dioxide snow has a wide range of usefulness, and is noted for the relatively slight amount of scarring which follows its use. Jackson and Hubbard advocate freezing by carbon-dioxide snow as the best treatment for **lupus erythematosus**; it is not necessary to freeze deeply. When the cone is dipped into ether, fifteen seconds are usually sufficient. **Nevi** and **angiomas** yield readily to freezing, although the latter may require a second application. **Port-wine marks** are best treated by applications of liquid air; other forms of **vascular and pigmentary nevi** are readily removed by either remedy. Firm pressure for one or two minutes and deep freezing are required in **hairy nevi**, to insure destruction of the hair-follicles. Morton strongly advises the use of the snow in **chronic localized eczema**. **Epithe-**

liomata, especially of the rodent-ulcer type, are cured more rapidly by the use of the snow, with less pain and scarring than by any of the caustics; firm pressure for one or one and a half minutes is necessary; in inoperable cases it should always be tried. Keratosis senilis, warts, papillomata, tattoo marks, powder stains, hypertrophied scars, keloid, tuberculosis verrucosa cutis, chloasma, and scrofuloderma have all been cured by freezing.

The treatment of trachoma by the use of the snow crayon is a somewhat delicate operation, several applications of quite short duration being necessary to cause disappearance.

C. SUMNER WITHERSTONE,
Philadelphia.

RELAPSING FEVER. (Famine Fever; Spirillosis; Febris Recurrens; European Relapsing Fever).—**DEFINITION.**—An acute infectious fever caused by Obermeier's spirillum (*S. recurrentis*) characterized by a febrile paroxysm of about six days' duration, followed by a remission of about equal length, and one or more relapses of both paroxysm and remission. Relapsing fever has been seldom met with in this country since 1869, when it occurred in New York and Philadelphia in epidemic form. The term relapsing fever, however, includes several diseases caused by different spirilla. The European relapsing fever is caused by *Spiroschaudinna recurrentis*, the North American by *S. nozvi*, the West African by *S. duttoni*, and the Indian by *S. carteri*. The symptoms and treatment of the European and American varieties are very much the same.

SYMPTOMS AND DIAGNOSIS.—

The period of incubation is from four to ten days or less; and in this stage malaise or fugitive pains may appear. The invasion is abrupt and may be marked with rigors or with slight shivering. With these are frontal headache, vertigo, severe pain in the back and joints, chills,

fever, and, particularly in young subjects, nausea and vomiting. Convulsions are occasionally observed in children. The pulse is rapid—110 to 140 or more, and the temperature is high—105° to 106° F. (40.5° to 41.1° C.), on the first or second day. This parallelism is important since it serves to differentiate relapsing fever from influenza, which disease it resembles. An attack of malarial fever is also suggested, the spleen being more or less enlarged almost from the start and profuse sweating being common. But the delirium which accompanies a high temperature, the prolonged duration of the paroxysm, the gastric symptoms, which are usually severe, serve to invalidate such a diagnosis. Typhoid fever is simulated in many instances, especially when petechiæ, which are sometimes observed, are present; but the rapid decline of practically all active symptoms after a few days clearly indicates the absence of this affection. Again, intestinal symptoms, except toward the crisis, are uncommon. Many manifestations of varying nature may appear in the course of the disease: jaundice, cough, parotitis, cervical adenitis, orchitis, edema of the feet, monarticular or polyarticular inflammations, laryngitis, and glossitis. Again, various eruptions may appear—roseola, purpura, urticaria, herpes, and the rashes of scarlet fever and measles. Hematemesis, hematuria, and epistaxis are occasionally noted. The most serious complications observed are pneumonia and acute nephritis. The intensity of the symptoms steadily increases, as a rule, until the crisis appears—from three to seven days after the onset of the access. Diarrhea and sweating are often the first signs of the remission; a rapid decline of temperature, to the normal or below, follows, and convalescence begins.

In about one-third of the cases the fever does not return; in the remainder a new attack appears after a week's comparative comfort. The previous symptoms once more prevail, and are followed, as in the former experience, by a sudden crisis, a period of repose, and a third attack. As a rule, the disease ends here; but two more recurrences may appear, each successive attack increasing the

patient's exhaustion. In weak and aged individuals death may thus be brought about; but, as a rule, the fatal issue occurs during or at the end of the first access. Deaths from rupture of the spleen have been reported. The fatality of the disease is small, being but 1.26 per cent. during the epidemic which occurred in Moscow in 1894, but it may reach 6 per cent., as was the case in the St. Petersburg epidemic.

Ulcerative conjunctivitis, various forms of paralysis, and the various complications occurring after exanthems are occasionally observed to follow the affection.

ETIOLOGY AND PATHOLOGY.—

The spirochetes responsible for the disease may readily be recognized in the blood, during the paroxysm, by their rapid movements among the red corpuscles. They practically disappear at the end of the attack, but reappear with each relapse. Where they are few, they are best detected by dehemoglobinizing a thick blood film on a slide with water, fixing with absolute alcohol, and staining with methylene-blue, carbol fuchsin, or better, Giemsa's stain.

The disease occurs especially in the presence of poverty, filth, insufficient or poor food, and other unhygienic conditions, but this seems to be due merely to the fact that it is amid such conditions the vectors of the disease, lice and certain ticks, are most likely to be present. Infection from lice has been found to occur chiefly, if not wholly, through scratching, with the crushing and rubbing of infected lice into the scratches, rather than through the bites of these parasites. The spirochetes, it is believed, may enter even through unbroken epidermis. The ticks transmitting the disease are various species of the genus *Ornithodoros*, and have the same nocturnal biting proclivities as bedbugs.

The morbid changes are not very marked; the spleen may, however, be greatly enlarged and soft, and the other viscera show evidences of degeneration. Nathanson noted changes in the cardiac ganglia, the degenerative process involving the protoplasm as well as the nucleus.

Sex and age seem to influence the development of the disease somewhat, as the disease is most common in young adults

between 15 and 25 years of age; a larger proportion of males than females are affected. Immunity against subsequent attacks is slight, since two separate attacks have been known to occur in a single season.

TREATMENT.—**Arsphenamin** has proven to be a specific in this disorder. It is given intravenously in doses of 0.2 to 0.25 Gm. It should be administered as early in the attack as possible. Defervescence and disappearance of the spirochetes from the blood take place in 12 hours after its use. In the few instances in which a relapse follows such medication, another dose of 0.15 Gm. will dispel it (Todd). In the absence of arsphenamin the treatment is symptomatic and ineffectual in shortening the illness. During intermissions the patient should remain indoors for at least 10 days, early exposure or sudden exertion predisposing to a relapse. S.

REMITTENT FEVER. See **MALARIAL FEVERS.**

RENAL CALCULI. See **KIDNEYS.**

RESECTIONS, AMPUTATIONS, AND CINEMATIC PLASTICS.—**RESECTIONS.**—Resection or excision of a joint means the removal of the articulating ends of the bones with the cartilages and synovial membrane, and is necessitated when the articulation is destroyed by injury or disease (usually tuberculosis), or by irreducible luxations or other forms of ankylosis where a more useful limb is desired. The limb is always shortened, and, in the young, if an entire epiphysis is removed, subsequent growth is interfered with.

Resection of the joints of the lower extremity, and others in which the greatest growth occurs and in which shortening would cause inconvenience, should be avoided if possible. As a rule, this operation should be limited to adult patients, and to the most severe cases of joint disease, in which mechanical treatment has failed, when there are large sequestra, where drainage and erosion will not meet the indications, and when a rapidly failing general condition demands this operation. It should al-

ways be one of the operations of last resort, in the same class with amputation.

When normal bone is removed to get at deeper parts, as in certain operations upon the jaws and the skull, it may be only partially separated, to be later replaced and attached; this is called **osteoplastic resection**. When an excision is made of a portion of the shaft of a bone, it is one **in continuity**; when of a joint extremity, **in contiguity**. If performed for injury and within a few hours thereafter, it is **primary**; if in the period of local disturbance during and after resection and before suppuration, it is **intermediary**; if after suppuration has occurred, **secondary**. Intermediary resections are not advised.

METHODS OF RESECTION.—Two general methods of resection are recognized. In the **subperiosteal or conservative method** the periosteum, joint capsule, and the attached ligaments and tendons are preserved. This is the ideal operation, since bone may be regenerated from the periosteum, and the joint movements retained by the muscles and their attachments. This method can, however, be rarely utilized for the reason that the ligaments, tendons, and capsular tissues are usually implicated, and in certain joints like the elbow new bone growth might inhibit free motion in the joint.

In the second or **radical method** the periosteum is not spared. The incisions are made so as to enter the joint by the most direct route and with the least injury to the contiguous tissues. Drainage is almost always a necessary feature of this method, either by gauze or rubber tubing.

SPECIAL RESECTIONS.

UPPER JAW.—Removal of the superior maxilla may be required on account of disease, non-malignant or malignant (sarcoma or carcinoma), or in the course of the removal of retromaxillary tumors. Though a bloody operation, it is singularly free from danger, the soft parts unite rapidly and the deformity is slight, a dental plate relieving the latter in large degree. By this operation sarcoma may often be cured or recurrence long postponed and in carcinoma the patient is

made more comfortable; life is not prolonged, and at times it is shortened.

Technique.—The bone is exposed by an incision over the infraorbital ridge from the malar bone to near the inner canthus, then along the side of the nose around the ala to the median line, and down through the middle of the upper lip. The flap so formed is reflected outward and dissected off the bone, and the free hemorrhage arrested by hemostatic forceps, pressure, and hot water. The malar bone is cut through with a fine saw, and later the ascending process close to its union with the frontal. The mucous membrane of the roof of the mouth is divided with a knife in the median line as far back as the soft palate, and laterally between the hard and soft palate, and the horizontal plates of the two maxillæ are separated from above downward with the saw. The bone is then removed with the lion-jaw forceps, or if, as frequently happens in malignant disease, the posterior wall is left behind, it can easily be removed. When not diseased, or when removal is not necessary to secure more room for further work, the orbital or alveolohorizontal plate may be left, the bone being sawn through just below the one or above the other; it is generally necessary, however, to remove the latter. Bleeding vessels having been ligated and general hemorrhage arrested, if necessary by actual cautery, the soft parts are replaced carefully along the line of incision and secured by fine sutures, the cheek-cavity filled with plugs of cotton or gauze to prevent oozing and to support the flap. A dressing of antiseptic gauze, covered with absorbent cotton and secured by a light bandage, is applied externally. The operation may be done through the mouth if only the lower part of the bone is to be removed.

If done to facilitate the removal of a pharyngeal growth, only the upper or inner bony attachment (malar-frontal, frontal-intermaxillary) should be divided, and the bone turned downward or outward, to be later replaced and reunited. The soft parts are not removed from the bones, but only incised at the point, the external portion acting as a hinge upon which the parts are turned back.

LOWER JAW.—Resection of the inferior maxilla is done for injury and for disease and may be in continuity, or of one-half, or of the whole. If in continuity and unilateral, it can often be done through the mouth, the soft parts being carefully drawn aside and the bone divided with a straight or chain saw, or even with cutting or gouge forceps. If in continuity and extensive, or if involving a half or more of the bone, an external incision of proper length should be made, and just below the lower border of the bone. The lower lip and the soft parts of the chin may or may not be divided in the mesial line, according as circumstances demand. If the middle portion is removed, all the attachments to the genial tubercles are secured, and tendency of the tongue to fall backward must be prevented by passing a ligature through it until the adhesions are sufficiently firm to prevent this accident.

Technique.—In resecting the half or the whole of the inferior maxilla, after separating the external and internal soft parts, well back toward the angle of the jaw, the bone is divided in the mesial line and firmly held off while the soft parts are further separated up to and including the coronary process. Disarticulation may now be effected, either by pulling or by a few cuts with the knife or scissors kept close upon the condyle. The periosteum should be preserved when the resection is done for disease unless the disease is malignant; division should be made through the body or at the base of the processes, whenever the object of the resection can be thus attained.

CLAVICLE.—Removal of a part or the whole of the clavicle may be done for disease, usually sarcoma. When done for other cause than malignant disease, and it has been possible to save the periosteum, regeneration of the bone, sometimes nearly perfect, may be looked for.

Technique.—The bone is exposed by a longitudinal incision, the soft parts being carefully but rapidly dissected off, and is divided internally to the affected area or disarticulated at the sternal junction, raised and cleared positively as far as required toward or to the scapular attachment, and there disarticulated or sawn

through. Hemostatic forceps are necessary to check the hemorrhage, often profuse when malignant disease is present. There is little danger of wounding the deep vessels and nerves, if the knife is kept close to the bone and the diseased mass.

After providing for drainage, the edges of the external incision are carefully coapted and sutured, and an antiseptic dressing applied, the arm being secured to the side.

Death may follow this operation from sepsis, shock, hemorrhage, or, later, from recurrence of the malignant affection.

SCAPULA.—Partial or complete removal of the scapula may be necessary for necrosis consequent upon injury, a benign or malignant tumor, the latter requiring complete excision, although a partial removal has been followed by no recurrence. When done for necrosis the operation is quite easy and simple; when for osteosarcoma, it is often difficult and attended by danger.

Technique.—In complete resection a single vertical incision may be made on line a little posterior to the middle of the spine and the soft parts reflected anteriorly and posteriorly; or an incision may be made along the whole posterior border, inclining forward at the upper end and forward and upward for a short distance at the lower end, following the anterior border, with usually an associated one over the course of the spine. The soft parts are then turned aside and the spinal muscles saved or left attached to the bone, depending whether the resection is not or is for malignant disease, the superior angle and adjacent upper border are freed from their attachments, then the posterior border and inferior angle, hugging the bone closely. The anterior surface is then cleared, after lifting up the scapula, and then the anterior border toward the glenoid fossa, the dorsal and subscapular arteries being ligated when reached. The acromion process is freed, the attachments of the scapular muscles divided close to the humerus, the coracoid process separated from its ligaments and muscles, and the glenoid fossa cleared. The bone is then lifted out, hemorrhage arrested, drainage provided for, the flaps

adjusted and sutured, and a compressing and retaining dressing applied.

SHOULDER.—Resection of the shoulder-joint is indicated in cases of severe injury, especially gunshot, rarely for compound fracture or relief of deformity. It may be made through an anterior oblique incision, three or four inches long, extending from the coracoid process downward and outward along the anterior border of the deltoid muscle, the patient's shoulder being raised, and the patient lying in the dorsal position, close to the edge of the table. The pectorodeltoid groove is opened, the cephalic vein and the pectoral muscles are retracted inward and the deltoid to the outer side, thus exposing the tendon of the biceps, at the outer side of which the joint capsule is opened. The elbow is next depressed, the humerus rotated inward, the supra- and infra-spinatus and teres minor are separated from the greater tuberosity, and the subscapularis from the lesser tuberosity after rotating the humerus outward. The tendon of the biceps is then reflexed by flexing the elbow, and displaced inward and the head of the bone luxated through the wound and divided with a saw. When the glenoid cavity is involved, the diseased bone is removed with a curette, or as a sequestrum. The arm, over an axillary pad, is bound to the chest, to prevent subcoracoid dislocation of the end of the humerus. As soon as the sutures are removed passive motions are begun.

ELBOW.—Resection of the elbow is indicated in certain cases of compound fracture, especially gunshot, of tuberculous disease, of old unreduced luxation, or of bony ankylosis. The incision is made upon the posterior surface of the joint in the median line from a point two inches above the articulation to one at or slightly below the line of junction of the olecranon with the shaft, or along the outer border of the triceps to the level of the epicondyle, and then downward and inward across the olecranon. The joint capsule is then opened and the soft parts dissected off on each side, preserving the periosteum if possible, until the condyles are well bared. Care must be taken not to injure the ulnar nerve. After flexing the forearm the lower end of the humerus

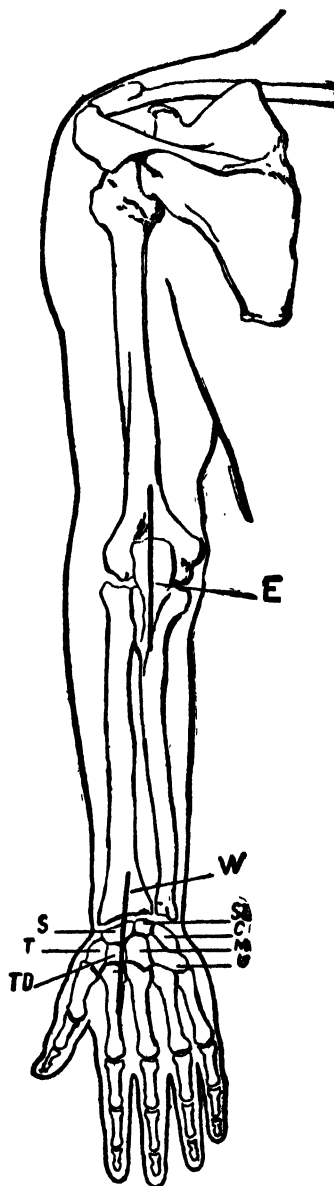


Fig. 1.—Left Arm, Posterior View. *E*, incision for resection of elbow-joint; *C*, cuneiform; *M*, os magnum; *S*, scaphoid; *SL*, semilunar; *T*, trapezium; *TD*, trapezoid; *U*, unciform; *W*, incision for resection of wrist-joint. (McGrath.)

is cleared, delivered through the wound, and sawn off; the upper ends of the radius and of the ulna are similarly treated. Instead of dissecting the soft parts from the

epicondyles and the upper edge of the olecranon, these bony surfaces may be chiseled off and turned aside without disturbing their muscular attachments. If a large amount of bone is removed, and a movable joint is improbable, the sawn surfaces may be united by wire or pins

for from seven to ten days, passive motion being then begun in the suitable cases.

WRIST.—Resection of the wrist is most often necessitated by tuberculous disease, affecting chiefly the carpus; more rarely by extensive injury, usually of the lower end of the bones of the forearm. The method will vary according as the resection is done for disease or injury. In the latter case lateral incisions down to or just below the joint level will suffice to give free access to the bone and allow its removal with small danger to the soft parts.

When the operation is done for disease, the carpal bones cannot be so easily reached nor removed without serious risk to the nerves and vessels. Three methods are suggested: a single long median dorsal incision, two lateral incisions over the dorsal surface of the wrist, or a transverse straight or curved division of the tissues covering the back of the wrist. The last affords readiest access to the diseased bones, but is objectionable because the tendons are necessarily severed; these severed tendons may, however, be sutured and good repair and perfect function be obtained. Of all resections, that of the wrist is the most unsatisfactory.

If the single, long, median, dorsal incision is preferred, as being easier of execution and disturbing the tendons least, it may begin at the middle of the radial border of the metacarpal bone of the index finger, and be carried upward, between the tendon of the long extensor of the thumb and that of the extensor indicis, to the dorsum of the radius between the extensor indicis and the short radial extensor of the wrist, the soft parts covering the carpus being carefully lifted and turned aside, and the periosteum being preserved as far as possible.

INTERPHALANGEAL JOINTS.—A lateral incision on the side of the joint and the division of the lateral ligament precede the luxation and sawing of the ends of the bones. If preferred, two lateral incisions may be made.

METACARPOPHALANGEAL JOINT.—Here a single lateral incision is made. The operation is then similar to the preceding one.

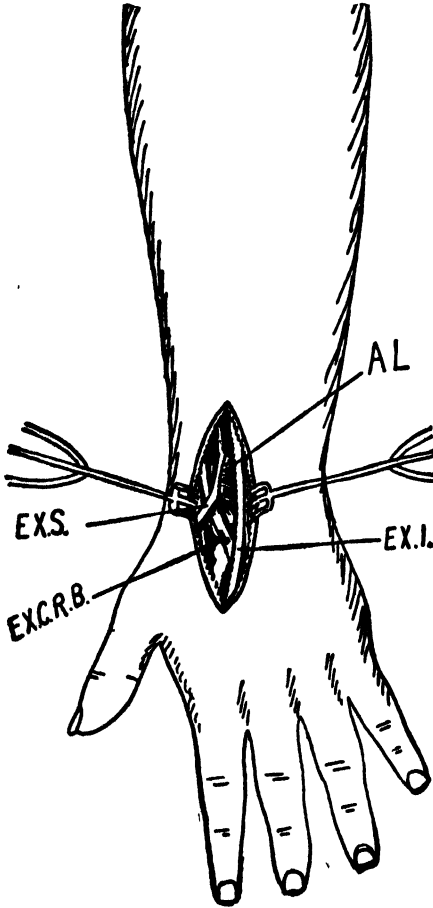


Fig. 2.—Resection of Wrist-joint. *AL*, annular ligament split to show the tendons of extensor secundi (*EX.S.*) and extensor carpi radialis brevis (*EX.C.R.B.*); *EX.I.*, tendon of extensor indicis. (*McGrath.*)

or a mortise and tenon joint may be formed of the ulna and humerus. If but little bone has been removed, more or less restoration of the functions of the elbow may be expected, at times so much as to allow the hand to be laid upon the shoulder. An internal angular splint may be placed on the forearm, to be retained

HIP.—In civil practice resection of the head of the femur is generally indicated because of tuberculous disease. The joint may be entered in three ways: anteriorly by the straight incision of Barker, laterally through a curved (White) or straight (Langenbeck) incision, and posteriorly through the angular incision of Kocher. In the use of the anterior incision no muscles are divided and the surrounding tissues suffer little damage, but the joint then lies at the bottom of a deep wound which is difficult of drainage. This incision begins about one-half inch below the anterior superior spine of the ilium, and extends downward and slightly inward for three or four inches. By drawing the tensor vaginae femoris and glutei outward, and the sartorius and rectus inward, the joint is exposed. Branches of the circumflex artery will be met which must be ligated. The joint capsule, cotyloid ligament, and periosteum of the femur are incised in the line of the wound, and when the air enters the joint the articulating surfaces may be parted and the ligamentum teres severed. The periosteum with the attached muscles is separated from the greater tuberosity, and the bone cut with saw or chisel, either above or below the trochanter major, as required. The acetabulum is curetted to remove the diseased area, and if drainage is desired a posterior counteropening is made.

The curved lateral incision of White begins about midway between the anterior superior spine of the ilium and the trochanter and is continued downward around the trochanter or across its outer surface along the outer border of the thigh for a short distance, the knife being carried down to the bone.

Langenbeck's external (or lateral) incision begins at a point three inches above the upper border of the trochanter downward over the trochanter for four or five inches in the long axis of the femur, the patient lying on the sound side with the thigh flexed at an angle of forty-five degrees. After this operation a Buck extension is applied to the leg, which is supported on the sides by sand-bags. The cavity becomes the seat of a fibrous deposit, which allows limited motion.

KNEE.—Resection of the knee may be required for injury, deformity, ankylosis, or most often for disease, and various incisions may be used. A curved incision across the anterior portion of the joint, with convexity downward below the patella, or with convexity upward above the patella, a straight transverse incision passing through the patella, which is sawn, with or without additional short longitudinal lateral in-

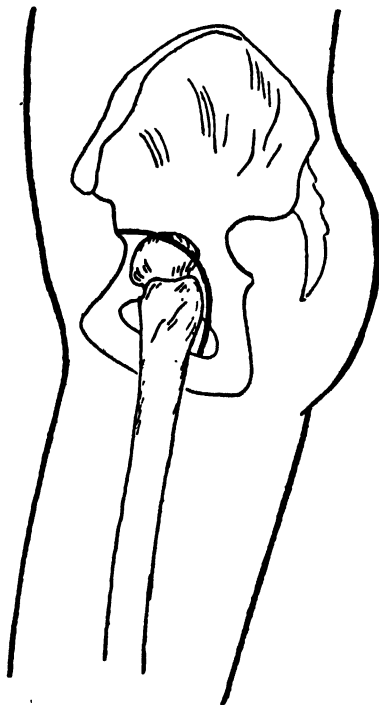


Fig. 3.—Resection of the Hip. Anthony White's incision. Commences anteriorly midway between the anterior superior spine of the ilium and the upper border of the trochanter major and curves backward above the trochanter major and then downward behind the trochanter for a distance of about two inches. (McGrath.)

cisions, or, finally, a single longitudinal incision, median or lateral, an incision not suited to cases of disease. Fixation and not motion is desired after resection of this joint.

The usual method is by making an anterior curved incision, from the posterior and upper border of one condyle to the other, the convexity of which reaches nearly to the insertion of the ligamentum

patellæ. The leg is then flexed to a right angle and the tissues divided in the following order: The superficial tissues, ligamentum patellæ, and the anterior lateral, capsular, and crucial ligaments. The popliteal artery and nerve being carefully avoided, the end of the femur is thoroughly exposed and a slice of the required thickness is sawn off, preserving the epiphyseal line if possible, especially

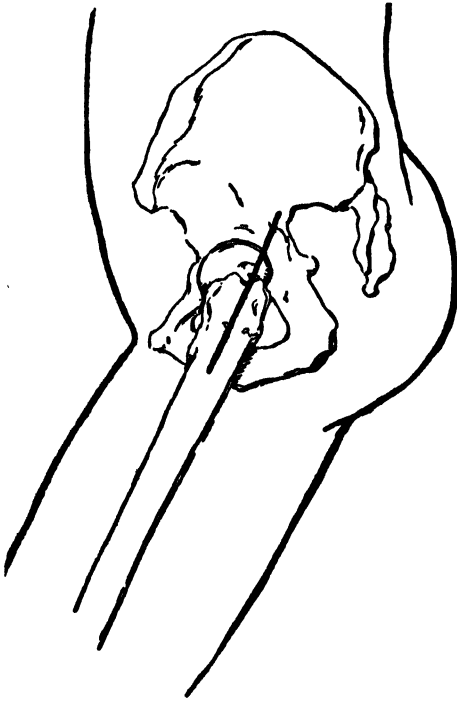


Fig. 4.—Resection of Hip. Langenbeck's incision. (McGruth.)

in children, as the chief growth of the femur is at its lower end; shortening is thus minimized. The saw should be carried in a slightly oblique direction from behind forward, parallel to the epiphyseal line. After removing the articular surface of the tibia in a like manner the diseased soft parts are cut or scraped away. As the patella and the synovial membrane are usually diseased they are removed with the bursæ, and a rubber drainage-tube is placed behind the bones, emerging at each angle of the wound. The bones may be fastened together with cat-gut, wire, nails, by suturing the ligaments,

or by the application of a fixed dressing. The edges of the incision are then sutured, an antiseptic dressing applied, and the limb immobilized by plaster of Paris or other suitable splint. Immobilization should be maintained for at least two, better for three, months and a posterior splint worn for several months longer, union in the position of nearly full extension being thus secured. The drainage-tubes are usually removed after a few days.

When the joint lesion is extensive and the general health much enfeebled, amputation offers the better chance of life and should be given the preference.

ANKLE.—This joint is seldom resected, as a more useful limb is obtained through the use of an artificial limb than from the ankylosed and fixed ankle-joint resulting from excision. Many methods have, however, been devised for the resection of this joint—lateral, transverse, posterolateral, and posterior, with and without the associated division of tendons and removal of the astragalus.

Langenbeck employs a hook-shaped incision around the lower end of the fibula three inches above the tip, passing along the posterior border, curving around the external malleolus, and then upward on the anterior border for one inch. The flap being lifted, the periosteum and overlying tissues are freed from the bone, which is divided at the upper end of the wound and drawn outward, when the ligaments at the lower end are cut. A second incision, one and one-half inches long, curves around the internal malleolus, and this is joined by a vertical incision two inches long in the median line of the tibia (anchor-shaped). The bone is then freed and removed as on the other side. The astragalus may be removed, wholly or in part, through either opening, the inner being preferred. (See Fig. 5.)

In the transverse method an incision is made across the joint connecting the malleoli. In this method, suture of the anterior tibial nerve and of the tendons complete the operation, and the foot at a right angle with the leg is immobilized in a fenestrated plaster cast.

FOOT.—The tarsal bones may be removed through lateral incisions, or by an incision across the dorsum, suturing the

divided tendons or allowing them to become attached while the wound is healing; suturing is to be preferred. Access to the diseased parts may be obtained by splitting the foot back between third and fourth metatarsals to the midtarsal joint.

An osteoplastic operation (Wladimiroff-Mikulicz operation) has been suggested when there is extensive ulceration or loss of tissue at the heel. It is only in these cases that it has any advantage over an excision. In this operation a flap of the posterior tissues from the level of the malleoli to that of the scaphoid tubercle is removed, the articulating end of the leg-bones and the posterior part of the scaphoid and cuboid are sawn through, the intervening bone excised, the foot placed in extension, the sawn surfaces being apposed, and the wound sutured. The body weight is supported on the ends of the metatarsals, and the under surfaces of the toes bent at a right angle.

IN CONTINUITY OF BONES OF THE LOWER EXTREMITY.—Because of almost certain non-union, the femur should not be the subject of this operation. When done upon the tibia or fibula, however, the prognosis is much better, since regeneration of the bone or compensatory hypertrophy of the untouched shaft frequently insures a successful result. During the period of repair especial care must be taken to prevent deviation of the foot. Operation upon a metatarsal or phalangeal bone of the foot, as also in the hand, may be readily done with prospect of good results; the incision is made over the inner or outer side, rather than the middle, to avoid injuring the extensor tendon.

When a first or second phalanx in the hand cannot be removed subperiosteally, the distal end of the finger should be allowed to drop back. The resulting fibrous union often becomes short and firm, making the finger a useful one, but, if otherwise, amputation is advised.

AMPUTATION.

DEFINITION.—Amputation when applied to the extremity is the removal of the limb in whole or in part in continuity. If performed through a joint it is called a disarticulation. Three varieties are recognized: *primary*, when the operation is

done immediately or soon after the injury; *secondary*, when done after many days, after the subsidence of fever, and *intermediary*, when done during the acute inflammatory stage, usually after two to four weeks or less.



Fig. 5.—Right Leg, Inner Side. AS, incision upon the inner aspect of the ankle for resection of the astragalus; K, Textor incision for resection of the knee-joint. Dotted lines indicate planes of section through the bones. (McGrath.)

INDICATIONS.—The great war has considerably modified prevailing views in this connection, the old mechanical conception entailing sacrifice of diseased and healthy parts to obtain a perfect stump having been replaced by efforts at plastic or reconstructive surgery. This newer conception, termed **Kineplastic surgery**, is

reviewed on page 825 of the present volume. The subject being comparatively new, however, the older views are also submitted, pending perfect adjustment of the various techniques involved.

As conceived before the newer views, injuries of equal degree involving the upper or lower extremity require different treatment because the collateral circulation is more free in the upper limb. Amputation would be imperative in the lower limb, while conservative treatment or excision would suffice in the upper extremity. In the aged, in alcoholics, in patients with chronic Bright's disease or tuberculosis, and in others with impaired assimilation and elimination, amputation is indicated. The aim is to save life and to provide for suitable artificial supports. *Compound fractures and dislocations* commonly demand amputation, especially where there is much comminution or loss of bone in a lower extremity, since the limb would be useless even if saved; when rupture of the main vessels are also present in a lower limb, amputation is indicated, while if in an upper extremity ligation of these vessels in the wound might permit the limb to be saved. Secondary hemorrhage from the main artery in the lower extremity generally demands amputation, while in the upper limb conservation may be justified.

Amputation is always imperative when there is great laceration or much mangle of the soft tissues, with extensive loss of skin and extensive comminution of bone and lacerated vessels. A limb that will be useless, if saved, usually demands removal. Compound fracture of the knee-joint, by reason of the great damage to the soft parts, often is a reason for amputation; if of the ankle-joint, conservatism may be tried if asepsis can be maintained; at least, if the soft parts are not much damaged excision may be done. The same rule applies to the shoulder and elbow, but a serious compound fracture of the wrist calls for amputation.

Compound dislocations of the shoulder, elbow, hip, and ankle are best treated by excision so long as the soft parts are only slightly injured, but in compound dislocations of the knee the popliteal vessels and the collateral circulation are so frequently damaged that amputation is safest.

Avulsion of an extremity in whole or in part demands amputation at a higher point, or when the entire limb is gone flaps must be made of the remaining portions of the soft parts, coapted as nearly as possible.

Lacerated and contused wounds with extensive comminution of bone (as in gunshot wounds) often demand amputation. Lacerated and wounded arteries are rarely an imperative demand for amputation except in the case of traumatic or diffuse popliteal aneurism, or that of the deep arteries of the leg, or for traumatic axillary aneurism; it is often indicated in secondary hemorrhage from a traumatized vessel or an artery ligated in continuity.

Gangrene from frost-bite, burns, traumatism, or from wounds of an artery, or its gradual occlusion in children, calls for amputation far above the diseased area; in senile gangrene, even, amputation of the leg or thigh is sometimes preferred.

Destructive diseases of the bones and joints, where the soft tissues are extensively involved, strongly indicate amputation.

Malignant tumors of the limbs, when they have invaded the bones or other important structures, so that they cannot be safely removed, demand amputation, the whole infected bone being taken away and the amputation being done at or above the joint on the proximal side of the disease.

Deformities, as severe club-foot, limbs that are useless through cicatricial bands, faulty union of fractures, etc., sometimes require amputation in young, healthy patients, usually to prepare the limb for a suitable appliance (artificial leg, etc.).

In injuries three points must be considered when treatment is contemplated: Is the blood-supply sufficient to prevent gangrene? Is the injury to the nerves and soft tissues so extensive that a useful limb cannot be obtained? Is it possible to prevent or control infection?

Primary amputation may be indicated after a bite from a venomous snake or after infection with very virulent organisms. Secondary amputation is often required for secondary hemorrhage, chronic sepsis, osteomyelitis, exhaustion or amyloid disease, or to remove a useless limb.

PRELIMINARY CONTROL OF HEMORRHAGE.—This is secured by applying an Esmarch band or other tourni-

quet, after the blood has been allowed to drain back into the circulation by elevating the extremity for several minutes. At the hip and shoulders the band may be prevented from slipping downward by long pins thrust through the tissues below the band, as suggested by Wyeth, by sutures encircling the band, or by a bandage placed beneath the band and around the trunk. Digital pressure may be used to occlude the main vessels where the elastic band is not advisable or applicable (atheroma, interscapulothoracic amputation, etc.), or the main vessels may be exposed by a preliminary incision and secured by clamp or ligature.

INSTRUMENTS.—These are a tourniquet (Petit's) or Esmarch's apparatus to arrest hemorrhage during the operation, knives, saws, cutting bone forceps, retractors, lion-jaw forceps (Ferguson's) to hold bone fragments, tenacula, artery and hemostatic forceps to secure the vessels, needles, sutures, scissors, and dressing forceps, and Halstead's "gut wool" or Horsley's "antiseptic bone wax" (beeswax, 7; almond oil, 1; salicylic acid, 1) for controlling undue hemorrhage from the bone, and retractors (two- or three-tailed aseptic bandage); after operation: drainage material (gauze, rubber tubing, or cigarette drains), antiseptic dressings, a splint to fix the joint above the amputation, bandages, etc.

METHODS.—These are numerous, but all are modifications of the *circular method*, in which the skin and superficial fascia are divided by a circular cut around the limb, and are dissected up so as to form a cuff, the muscles cut down to the bone, and the bone sawn higher up; and of the *"flap method,"* in which the bones are covered by variously shaped "flaps" of skin, fascia, and muscle. In both methods sufficient periosteum should be provided to cover the bone, muscular tissue to cover the periosteum, and skin to fully cover the muscle. The line of union which forms the subsequent scar tissue should be so arranged that the scar shall not be subjected to pressure. The flaps should not fit too closely, as the tissues contract considerably after operation, but should be somewhat ample.

THE CIRCULAR AMPUTATION.—By a circular sweep of the knife the skin and the subcutaneous tissues are divided around the whole circumference of the limb

and dissected back like a cuff. The superficial and then the deep muscles are divided in like manner at a higher level, so that the upper cut surfaces resemble a hollow cone. The periosteum is then divided and reflected in a similar manner, and after retracting the soft parts with a wide two-tailed muslin bandage the bone is sawn high up, next to the cuff of periosteum, and the latter is drawn down over it after arresting all hemorrhage from the bone. The skin incision should be at least two-thirds of the diameter of the limb (at the point of sawing the bone) below the level of the plane in which the bone is divided. The circular amputation is seldom used except for the arm, as the stump usually becomes conical and the scar is opposite the end of the bone. The *oval amputation* (Kocher) is a modification of the circular, in which an oblique or elliptical incision is made around the limb, the distal portion is dissected up, a circular division of the muscles being made slightly below the proximal part of the incision, and the free convex border is sutured to the concave portion. In the *racquet amputation* (Kocher), another modification, a straight incision is made in the axis of the limb (handle of the racquet) and a circular or oval incision is made around the limb (rim of the racquet). A short flap of skin and subcutaneous tissues is made; the muscles are divided obliquely.

THE FLAP AMPUTATION.—The flaps in the amputation may be either *lateral* or *anteroposterior* and *single* or *double*, and are used in operations through the shafts of long bones. The flaps may consist of skin alone, or of muscle and skin. When the muscle is included there must be enough skin to cover the muscle, enough muscle to cover the bone, and the bone must be sawn above the angle of junction of the flaps. The flaps should be half the circumference of the limb in width, and the aggregate length of both flaps should be at least five-eighths of the circumference of the limb at the point where the bone is divided. Though the incision is made more rapidly by transfixion, there is apt to be a redundancy of muscle; a better stump can be made by cutting from the skin inward, or one flap may be made in that manner and the other by transfixion. Musculocutaneous flaps are desirable, for by using buried ani-

mal sutures all cavities may be obliterated, and all drainage, except capillary, can be omitted, which is impossible when cutaneous flaps are made.

MIXED METHOD OF AMPUTATION.—In this method two semilunar, or rectangular (with rounded corners) flaps are made on opposite sides of the limb. These flaps of skin, subcutaneous tissue, and fascia are turned back and the muscles divided circularly at the level at which the bone is sawn. The best is where the semilunar flaps are made as suggested by Syme.

PERMANENT CONTROL OF HEMORRHAGE.—Before removing the tourniquet or Esmarch's band, the large vessels are picked up with hemostatic forceps and ligated with chromicized gut or silk. As the tourniquet is being loosened, the smaller vessels are seized with hemostats and ligated. Pressure with antiseptic gauze or very hot water will control the capillary oozing. Nerves and tendons should be drawn out and cut short, and with rongeur forceps any sharp or projecting spiculæ of bone are removed. Hemorrhage from the bone may be arrested by using Horsley's bone wax.

DRAINAGE AND CLOSURE OF WOUND.—Drain the oozing surfaces with gauze (strips or cigarette) or rubber tubing emerging at the lowest part of the wound. The flaps of periosteum and muscle are sutured over the ends of the bones with catgut and the skin flaps secured with silk-worm gut. An antiseptic dressing is applied and the stump, firmly bandaged, is placed on a pillow or in a splint. The drain may be removed and dispensed with in forty-eight hours if there is no infection present.

THE STUMP.—When healed the stump should be round, freely movable and without pain, even on deep pressure. The scar should not adhere to the bone and should lie without the pressure area. The stump tissues atrophy. The end of the bone becomes smooth and its medullary cavity becomes covered in with bony tissue. Necrosis of the end of the bone may follow, if it has been deprived of its periosteum, especially if followed by infection. *Sloughing of the flaps* may occur when the amputation is done too close to the diseased area, from too thin flaps, when the patient is constitutionally debilitated from diabetes, or

when the flaps are too thin, or where atheroma is present and, when extensive, may require reamputation. *Neuralgia of the stump* occurs when a nerve becomes imbedded in the scar tissue, or from the formation of a neuroma; excision will remove either cause, or the nerve may be cut off higher up or reamputation may be required. Senn advised the removal of the bulbous end of the nerve by a V-shaped incision and suture of the nerve-flaps to prevent recurrence. *Spasmodic stump* may complicate neuralgia of the stump, and is cured by the same means. Relief is not obtained, however, when it has a central origin. *Conical stump* may be due to too short flaps, cicatricial contraction following infection, and, in children to a continued growth of bone; the end of the bone may protrude in aggravated cases. Reamputation here is necessary. *Ulceration of the scar* may be due to thinness of scar, especially when adherent or submitted to pressure; it may, however, be caused by constitutional disease (syphilis). When extensive the only relief is from reamputation. *Epithelioma* of the scar tissue is not rare.

SPECIAL AMPUTATIONS.

AMPUTATION THROUGH A PHALANX.—This may be done either by two semilunar flaps or by a single palmar flap. It must be borne in mind that the joint in the last row of phalanges is one-twelfth of an inch below the most prominent part of the knuckles; in the middle row, it is one-sixth of an inch below, and at the metacarpophalangeal joint one-third of an inch below. A narrow, sharp-pointed bistoury is used, and the flaps are cut from within outward. The lateral ligaments are divided and the knife-edge, entered on the dorsal aspect of the joint, is passed between the bone and carried downward and forward, severing the palmar ligaments and completing the disarticulation.

AMPUTATION AT THE METACARPOPHALANGEAL JOINTS.—Double lateral flaps may be used, or the patient's hand being pronated a longitudinal half-inch cut is made over the head of the metacarpal bone, the incision being then carried obliquely down on one side to the interdigital web across the base of the phalanx and upward to meet the longitudinal

incision, dividing the tissues down to the bone. The tendons and lateral ligaments are then divided and the disarticulation completed. All the fingers may in this manner be separately removed; or by a transverse dorsal incision we may effect disarticulation, a palmar flap being made from within outward.

AMPUTATION OF THE THUMB AND LITTLE FINGER.—The modified oval method advised for the disarticulation of the entire fingers is well suited for amputation of the little finger and amputation of the thumb through its metacarpal bone or with this bone.

AMPUTATION OF THE METACARPUS.—When a portion or all of the metacarpus, either alone or with a portion of the carpus, is to be removed the formation of the flaps must be governed by the condition of the tissues.

AMPUTATION AT THE WRIST.—This may be made by an elliptical incision, one-half inch below the articulation on the dorsal side and two inches lower on the palmar side, passing between the pisiform and the base of the metacarpal on the ulnar and crossing the carpometacarpal joint on the radial side, opening the joint from the dorsal surface. In Dubreuil's method an external lateral flap is made by an incision

muscular tissue of the thenar eminence. A circular incision on the ulnar side connects the ends of the flap. The wrist is then disarticulated. If desired, a long palmar flap reaching to the middle of the metacarpal bones may be used.

The circular method is preferred by many, the circulation being controlled through the



Fig. 7.—Exarticulation of the Finger. A, incision for exarticulation at the metacarpophalangeal joint; B, incision for amputation of finger with excision of the head of the metacarpal bone; C indicates long anterior flap in exarticulation through the phalango-phalangeal joint. (McGrath.)

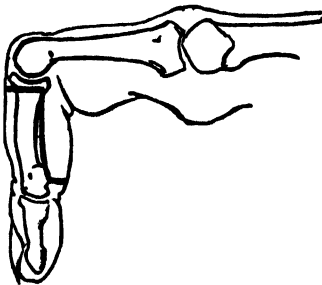


Fig. 8.—Exarticulation of the Finger at the Phalango-phalangeal Joint. The arrow indicates level of the joint when the finger is flexed. Heavy line indicates the long anterior flap. (McGrath.)

beginning at the junction of the middle and outer thirds of the dorsal surface of the wrist, curving downward to the head of the metacarpal bone of the thumb, and then passing upward upon the palmar surface to a point opposite the starting point. It is well to include in the flap some of the

brachial artery. The incision is made from one to one and one-half inches below the radiocarpal joint, the flap reflected, and the joint opened from the radial side. After disarticulating the joint, the vessels (three or four) are secured.

AMPUTATION OF THE FOREARM.—Here any of the flap methods may be used. The muscles are divided by a circular cut, the interosseous membrane severed, a three-tailed muslin retractor applied and both bones sawn at the same time, after making a slight groove in the radius as a guide. The circular method is sometimes used, but the anteroposterior musculocutaneous flaps are preferred, being cut from without inward. The tendons, in Vanghetti's operation—also known as cinematic amputation—are cut longer than the bones, and by suturing the ends together or by turning the tendons back upon themselves loops are formed, or knobs are made by tying the ends in knots or by chiseling off the bony insertion. These loops or knobs are im-

bedded in the skin flaps, so that when healed they may be attached to hooks or strings for the purpose of transmitting movement to an artificial limb.

AMPUTATION AT THE ELBOW.

—The results of this operation are unsatisfactory, amputation either above or below the joint being preferred. The elliptical or

or by cutting from without inward. The anterior flap should be the longer, as the biceps contracts more than the triceps, and the bone must be carefully cleaned behind. The brachial and superior profunda arteries and several smaller vessels require ligature.

Single or double flaps can be made if the location of the disease or injury prevents the use of the anteroposterior flaps.

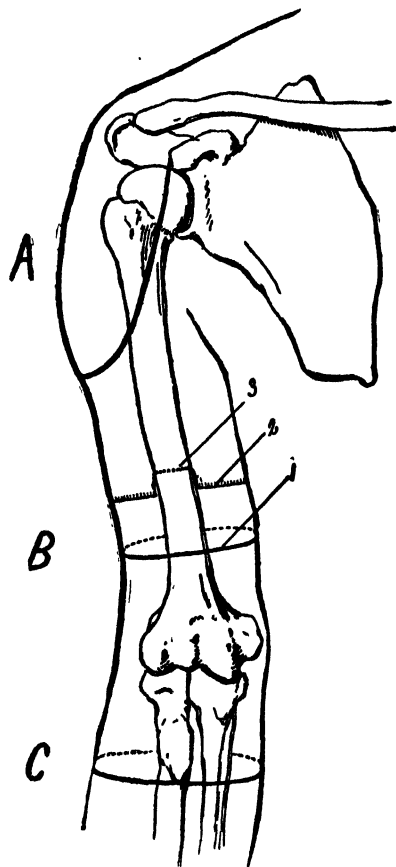


Fig. 8.—Right Arm, Anterior Aspect. *A*, outline of the lateral deltoid flap in exarticulation at the shoulder-joint; *B*, amputation through the arm; 1, incision through the skin; 2, incision through the muscle; 3, line of division through the bone; *C*, incision for exarticulation through the elbow-joint (circular method). (*McGrath*.)

long anterior flap methods or the flap method of Guérin may be used.

AMPUTATION OF THE ARM.—

While the circular method does well here, the anteroposterior flap method is better. The flaps are made either by transfixion



Fig. 9.—Right Shoulder, Posterior View. Outline of the lateral deltoid flap for exarticulation at the shoulder-joint. (*McGrath*.)

AMPUTATION AT THE SHOULDER.—

The classical operations are those of Larrey, Dupuytren, and Spence.

In the oval or Larrey's method the circulation is controlled by compressing the subclavian artery against the first rib. The point of a medium-sized knife is entered below and just anterior to the top of the acromion, making a six-inch longitudinal cut down the outer side of the arm. The oval incision begins at the center of the longitudinal cut and is carried obliquely around the

arm. The flaps are reflected from the outer aspect of the joint, and the extremity removed.

In Dupuytren's method there is a U-shaped flap extending from the coracoid process to the root of the acromion, the lowest point being at the insertion of the deltoid. The inner flap is formed by an incision joining the ends of the former and extending two inches below the axilla. Disarticulation is done as in the other methods.

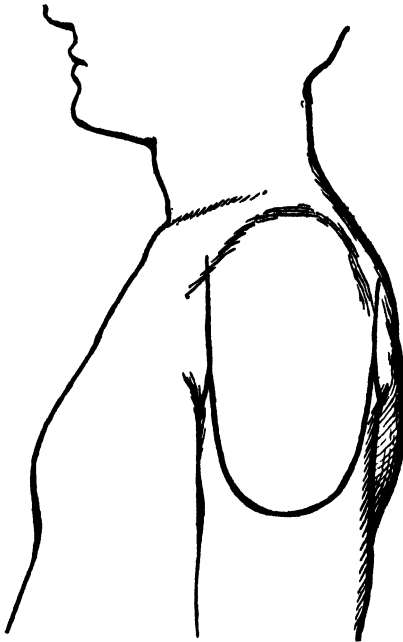


Fig. 10.—Left Shoulder, Side View. Outline of the lateral deltoid flap for exarticulation at the shoulder-joint. (McGrath.)

In Spence's method an incision down to the bone is made from midway between the coracoid and acromion, downward and outward for three or four inches. The joint may be opened at once for examination if desired. The incision is then carried downward and inward across the axillary fold and around the arm to the end of the first incision. After reflecting the skin for an inch or more, the muscles on the inner aspect are divided obliquely, exposing the axillary vessels, which are ligated and divided. The soft parts on the outer side are detached from the bone, the inner half of the capsule and the subscapularis divided, the head of

the humerus drawn outward, the division of the capsule completed, and the remaining tissues freed by carrying the knife downward close to the inner side of the bone, to avoid injuring the posterior trunk of the circumflex artery.

INTERSCAPULOTHORACIC AMPUTATION.—In this amputation we remove the entire upper extremity, arm, scapula, and the whole or a part of the

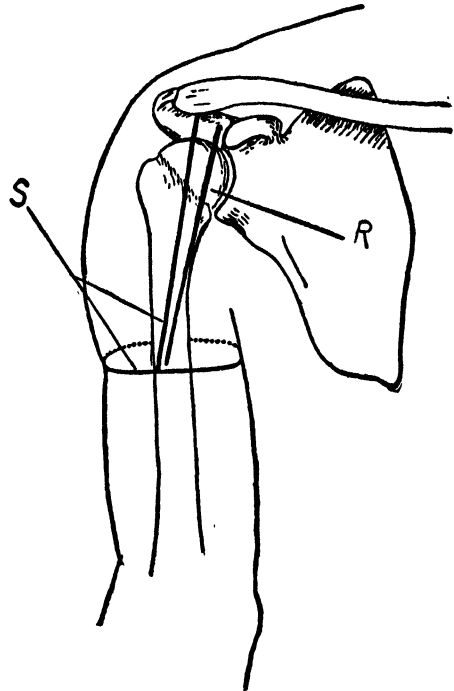


Fig. 11.—Right Shoulder, Anterior View. *R*, line of incision for resection of shoulder-joint; *S*, incision for exarticulation at the shoulder-joint. (Spence.)

clavicle. Preliminary control of hemorrhage is secured by ligating the subclavian vessels through an incision made along the clavicle after resection of the middle third of the clavicle (Berger's method), or after disarticulation of its sternal end (Le Conte's method), puncture of the pleura being carefully avoided. The anterior flap is formed by making an incision from the center of the clavicular incision downward and outward across the axillary fold and backward to the lower angle of the scapula. The muscles are divided, and the exposed brachial

nerves are cut on the same level as the sub-clavian vessels. The arm is then carried across the chest, and by joining the ends of the two previous incisions a posterior flap is formed. After detaching the scapular muscles the whole limb is removed.

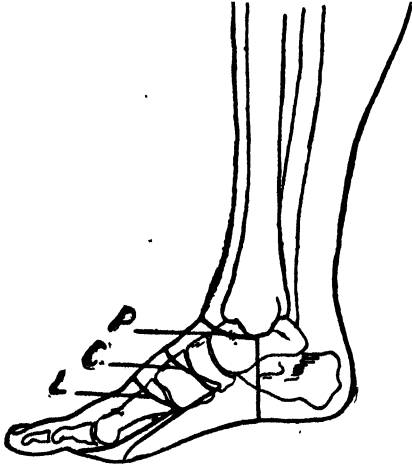


Fig. 12.—Right Foot, Inner Side. C, incision for Chopart; L, incision for Lisfranc; P, incision for Pirogoff. (McGrath.)

AMPUTATION OF THE TOES.—

With the exception of the great toe amputations are always made at the metatarsophalangeal articulation. This operation is identical with that for the fingers except that the joint is the same distance behind, as the tip of the toe is in front of the web. The oval method may be used. When *all the toes* are to be removed the joints are opened by a dorsal incision with convexity downward, dividing the tendons, disarticulating, and making a plantar flap by passing the knife, on the flat, behind the bones. In removing the *great toe* by the oval method, the preliminary longitudinal incision is made to curve somewhat upward over the base of the metatarsal bone to give more room. The same method may be used in removing two or more toes with their metatarsals, the incision starting one-half inch above the tarsometatarsal joints, and directing it so as to include the toes to be removed.

AMPUTATION THROUGH THE METATARSUS.—A short dorsal flap, slightly convex downward, is cut from within outward, and a long plantar one. These are freed and the bones sawn across.

The line of union will be on the dorsum of the foot.

AMPUTATION THROUGH THE TARSMETATARSAL JOINTS.—

In *Lisfranc's operation* a curved incision, convex downward, is made, running from the base of the first metatarsal across the dorsum of the foot to the base of the fifth. A long plantar flap is made, including all the tissues to the bone. Reflect the flap slightly and disarticulate first the outer three metatarsals, then the first, and finally the second by cutting upward between its base and the internal cuneiform for about half an inch; the same is done on the outer side and the separation is completed by a transverse cut, severing all the ligaments between the middle cuneiform and the base of the metatarsal bone. In *Hey's operation* the outer four metatarsals are disarticulated, and the internal cuneiform bone is sawn off in a line with the other metatarsal articulation. In *Bauden's method* the first metatarsal is disarticulated and the remaining ones sawn through at the same level. In *Skey's method* the base of the second metatarsal is sawn through.

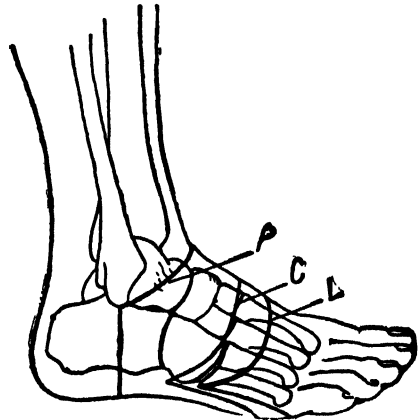


Fig. 13.—Right Foot, Outer Side. C, incision for Chopart; L, incision for Lisfranc; P, incision for Pirogoff. (McGrath.)

AMPUTATION AT THE MEDIO-TARSAL JOINT.—

In *Chopart's operation* a dorsal incision is made from the inner side of the tuberosity of the scaphoid, which curves forward to within an inch of the ends of the metatarsal bones, to the outer side at a point midway between the outer malleolus and the base of the fifth

metatarsal. Forcibly depress the anterior portion of the foot, and disarticulate by severing the ligaments. The knife is then slipped behind and under the bones, and a large plantar flap is formed somewhat longer on the inner side.

SUBASTRAGALOID OPERATION.

—The stump in this operation, covered by the skin of the heel, is a useful one. The incision is racquet-shaped, starting at the insertion of the tendo Achillis, and passing along the outer side of the foot to a point just above the base of the fifth metatarsal, when it is continued around the foot. After reflecting the dorsal flap the tendo Achillis is severed, the astragaloscaphoid joint opened, the foot twisted inward, and the astragalus removed from the os calcis. The latter is then cleared and the foot removed.

AMPUTATIONS AT THE ANKLE-JOINT.

—In Syme's amputation the ankle-joint is disarticulated and the articular surface of the tibia and the malleoli are removed. The incision, made down to the bone, begins at the top of the external malleolus, and passes down under the heel to a point one-half inch below and behind the internal malleolus. The tissues of the sole back of the os calcis are dissected off, hugging the bone closely, until the point of the heel is passed; the tendo Achillis is then severed. The ends of the first incision are united by a transverse incision across the instep, the joint is opened, the lateral ligaments divided, and the disarticulation completed. Finally the ends of the tibia and fibula are cleared, the malleoli sawn off with a small section of the articular surface of the tibia.

In *Pirogoff's amputation* the posterior portion of the os calcis is sawn off and applied to the sawn ends of the tibia and fibula. The plantar incision, forming a right angle with the dorsal, is carried obliquely forward instead of vertically downward. The lower ends of the tibia and fibula are sawn obliquely and nearly parallel with the sawn surface of the os calcis. The bones are then wired together or held in place by catgut sutures, including the periosteum. The limb is then secured on a posterior splint. *Le Fort's modification* consists in sawing the tibia and os calcis horizontally, while in *Ferguson's method* the malleoli are

allowed to remain and the fragment of the os calcis is adjusted between them. (See Figs. 12 and 13.)

AMPUTATION OF THE LEG.—The choice of method will depend largely upon the level at which amputation is made. In

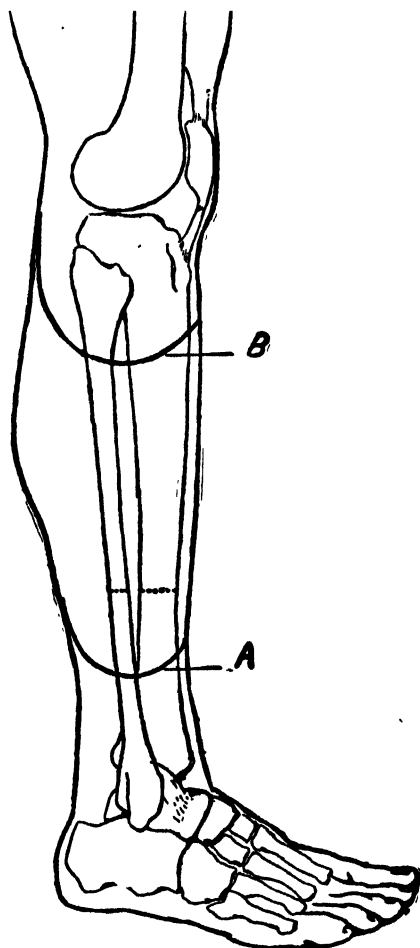


Fig. 14.—Right Leg, Outer Side. A, outline of hooded skin flap in amputation of the leg. Dotted line shows line of division through bones. B, outline of the skin flap in Stephen Smith hooded flap for exarticulation at the knee-joint. (McGrath.)

the lower third the modified circular may be used, although lateral flaps of equal length are preferred by many. Osteoplastic flaps as suggested by Moschowitz may be fashioned from the malleoli to cover the ends of the tibia and fibula, care being exercised

that they are on the same plane as the articular cartilage of the tibia.

In *Teal's operation* two rectangular flaps, including all the tissues down to the bone, are made. The long anterior flap should be equal in length and breadth to one-half the circumference of the leg at the site of amputation; the short posterior flap, which

tion is vertical, a dependent angle allowing adequate drainage.

In all leg amputations a better stump will be obtained by removing one-half inch more of the fibula than of the tibia. The sharp tibial crest should be beveled by sawing the tibia for an inch obliquely from above downward and backward, and then by a



Fig. 15.—Section through the Middle of the Right Leg. A.A.V., anterior tibial artery and vein; G.E., gastrocnemius externus; G.I., gastrocnemius internus; P.B., peroneus brevis; P.L., peroneus longus; P.V., peroneal artery and vein; P.V.N., posterior tibial artery and nerve. (McGrath.)

contains the larger blood-vessels, should be one-quarter the length of the anterior long flap.

In the middle and upper thirds two lateral flaps of equal length may be satisfactorily used, but *Sédillot's method* is to be preferred, in which the external flap is long and the internal short. The anterior and posterior tibial and peroneal arteries, with two or three smaller branches, will require ligature. The line of union in this opera-

fresh transverse cut. Osteoplastic flaps have been used by Bier and von Eiselberg to cover over the medullary cavity and to render the skin flap movable.

AMPUTATION AT THE KNEE-JOINT.—This may be made by using bilateral flaps, the inner one longer (*Stephen Smith's method*); or a long anterior quadrilateral cutaneous flap with rounded corners, the incision being made from one condyle to the other, extending to a point five inches

below the patella) and a short, curved incision uniting the ends of the former. The patella may or may not be removed.

AMPUTATION ABOVE THE KNEE.

—This amputation, also called supracondyloid amputation of the femur, is made, by *Carden's method*, by dissecting up a large, rounded, anterior, cutaneous flap, dividing the tissues behind by a transverse cut and severing the muscles in a similar manner down to the femur in front above the patella, which, by flexing the knee, is drawn downward. The operation is completed by

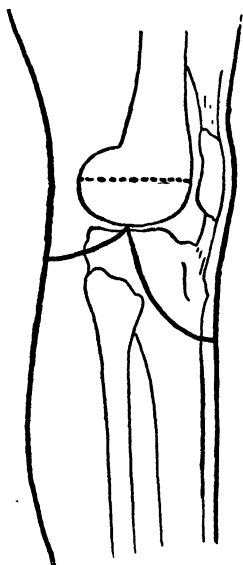


Fig. 16.—Right Leg. Carden's Amputation. Solid line indicates flaps. Dotted line shows line of division through the condyle. (McGrath.)

sawing through the base of the condyles just below the epiphyseal line.

In *Gritti's osteoplastic method* the anterior semilunar flap extends from the condyles of the femur to the tibial tubercles and includes the quadriceps extensor tendon and the patella; the posterior flap is made by an incision connecting the ends of the anterior. The femur is sawn across above the condyles, the cartilaginous surface of the patella is then removed with a fine saw, and the two freshened osseous surfaces maintained in apposition by sutures of wire or catgut.

Sabanejeff uses a bone flap from the tibia to cover the end of the femur.

AMPUTATION OF THE THIGH.—

Any of the usual methods may be used. The flap and modified circular methods are perhaps best. In high amputations where the tourniquet or Esmarch band cannot be

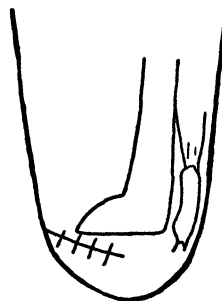


Fig. 17.—Stump After Carden's Amputation. (McGrath.)

used, Wyeth's pin method or digital compression of the femoral against the pelvic brim may be necessary.

Amputation through the trochanters is less dangerous than exarticulation of the hip, and may be done for injury or malignant disease; in the latter case, if the bone is found to be

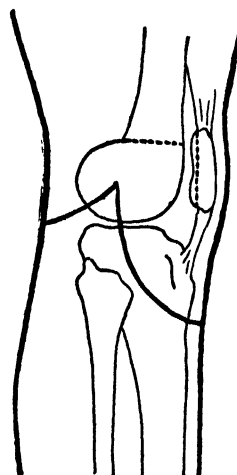


Fig. 18.—Gritti-Stokes Amputation. Solid lines indicate flaps. Dotted lines show section through femur and patella. (McGrath.)

diseased, the remaining fragment may be dissected from the joint.

AMPUTATION AT THE HIP-JOINT.

—In this operation there are unusual dangers from hemorrhage, shock and sepsis. To diminish shock the patient's body and the

other three limbs may be encased in cotton secured by bandages. To control hemorrhage the femoral vessels may be exposed and ligated, the smaller vessels being secured by hemostatic forceps as they are divided; this is perhaps the best method. Pressure upon the aorta by various forms of tourniquets and pressure upon the ex-

"One pin is inserted one-fourth of an inch below and within the anterior superior spine of the ilium, and, after traversing the muscles and fascia on the outer side of the hip, emerges on a level with the point of entrance. The point of the second pin is thrust through the skin and tendon of the origin of the adductor longus muscle, one-

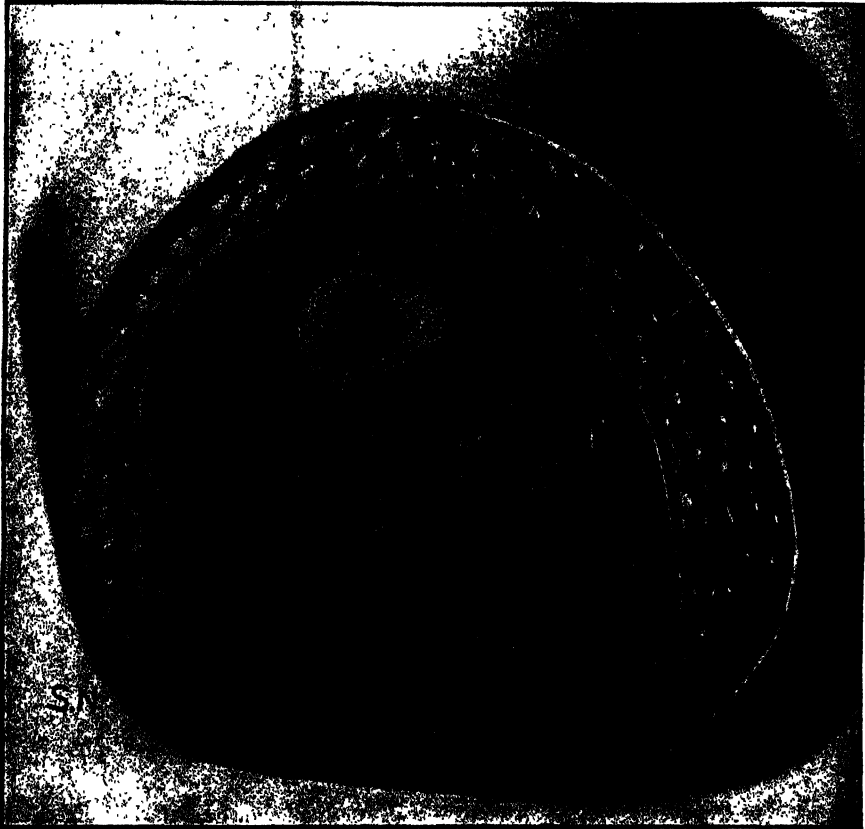


Fig. 19.—Section through the Middle of the Right Thigh. A.V., femoral artery and vein; G., gracilis muscle; R., rectus muscle; S.N., sciatic nerve. (McGrath.)

ternal iliac vessels with Davy's rectal lever are both dangerous. Direct digital pressure on these vessels, as suggested by McBurney, is safe but tiresome. Pressure by a rubber tourniquet secured to the pelvic brim by two long steel pins (Wyeth's), by sutures or by a loop passing around the abdomen is safe, the Wyeth method being most used.

Wyeth's Bloodless Method.—The limb is first exsanguinated by applying a rubber bandage from the toes up to the trunk.

half inch below the crotch, the point emerging one inch below the tuber ischii. The points should be shielded at once with corks to prevent injury to hands of the operator. No vessels are endangered by these skewers. A piece of strong white-rubber tubing one-half inch in diameter when unstretched, and long enough when in position to go five or six times around the thigh, is now wound tightly around above the fixation needles." The Esmarch bandage is then re-

moved. An external racquet incision is used, the external portion of which extends downward for six inches from the rubber band, and is then completed by a circular incision around the thigh. The skin and subcutaneous tissues are reflected to the lesser trochanter and the muscles severed at this level. The capsule of the joint is opened and the head of the bone forced from

are divided by the circular sweep through the muscles. If the artery is not to be ligated after the skin flap has been reflected, the abdominal tourniquet, digital pressure or other means for controlling the hemorrhage must be used. Liston advised an anteroposterior flap method. *Larrey's operation* is the lateral flap method, useful when the injury or tumor for which opera-

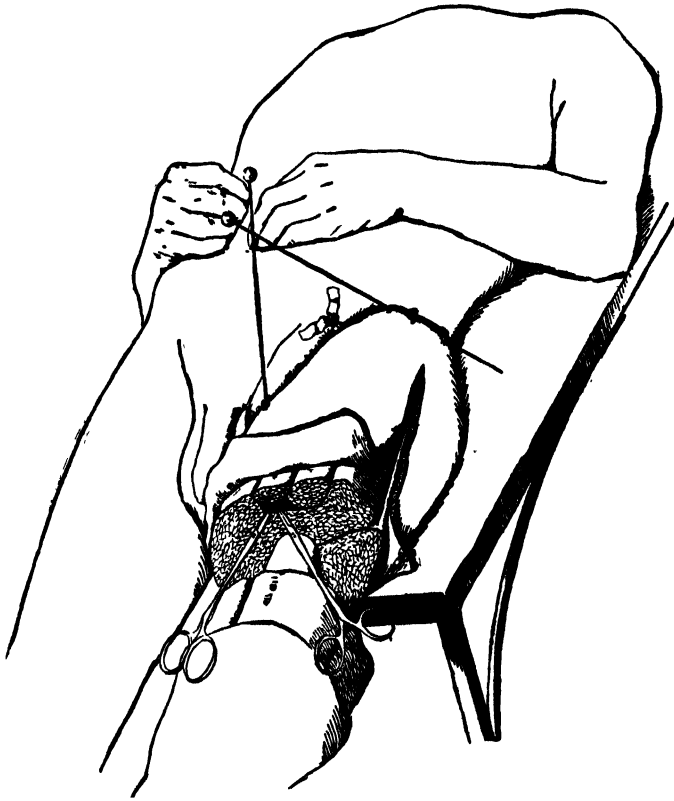


Fig. 20.—Exarticulation at Hip-joint. Wyeth pins in place to prevent ligature from slipping. Upon the outer side of thigh the incision reaches to the bone. A circular flap has been turned back and the muscles and blood-vessels divided down to the bone. Clamps applied to femoral artery and vein. (McGrath.)

the socket by carrying the thigh upward, inward and forward. The round ligament is cut and the limb removed.

The *modified circular operation* is useful when a tumor involves the muscles high up. Short anteroposterior skin flaps are used, a circular cut of the muscles being made at the joint level, and disarticulation performed. After the flaps have been reflected the femoral vessels can be tied, before they

tion is required necessitates lateral flaps. *Esmarch* divides the femur at the level of the circular incision, ligates all the blood-vessels, removes the constrictor, and then enucleates the upper end of the bone.

The *anterior racquet operation* without the use of a constrictor is perhaps the best method (Stewart). In this a longitudinal incision three inches long is made from the middle of Poupart's ligament downward.

The common femoral vessels are divided between ligatures, and the incision is continued downward and inward across the inner side of the thigh about four inches below the crotch, and thence around the thigh to meet the first part of the incision. After separating the outer flap, which includes the muscles, from the femur, the bleeding vessels are ligated as they are discovered. Rotating the limb outward, the process is repeated on the inner side. After opening the capsule the head of the bone is disarticulated forward, the round ligament divided, and the tissues on the posterior surface severed by cutting downward and outward behind the bone.

INTERILIOABDOMINAL AMPUTATION.—In this operation the entire lower extremity, including the whole or a part of the innominate bone, is removed. Ransohoff performed this operation thirty-four times, with ten recoveries.

SUMMARY OF WAR AMPUTATIONS.—A study of the functional status of amputations during the most violent activities of the war, and based on nearly 2500 operations by himself and others was prepared by Tuffier for the Paris Academy of Medicine (Surg., Gynec. and Obstet., Aug., 1916). It demonstrated that a considerable percentage had to be operated 2 or more times, and that after amputation a mutilated soldier had 30 out of 100 chances of having to submit to a new operation. The **reamputations** usually involved the lower extremity, being generally called for because of the classical circular incision. The lesions which rendered an amputation stump unfit for an artificial limb were, in order of frequency: incomplete cicatrization by ulceration or fistula; pains, spontaneous or provoked by the apparatus pressure; often these causes combined. The ulcerations were often caused by too short or scant flaps or diseased bone or nerves and lack of post-operative care. All urgent amputations being as a rule, infected, periosteal denudation should be carefully avoided, being unnecessary and dangerous.

Caries and necrosis were common reasons for reamputation.

The practical conclusions drawn by Tuffier for each variety of amputation are as follows:—

A hip amputation should be made as low as possible, leverage being of cardinal importance, especially in the upper third of the femur. A stump of 10 cm. is the minimum required for the prosthetic apparatus. A femur 14 to 15 cm. long is necessary.

A sub- or intra- trochanteric amputation, or of the upper fourth of the femur, is hard to fit with apparatus and the amputated walk on the pelvis. It should, however, not be abandoned. To diminish the inconvenience the femur should be straightened as much as possible during the healing of the wound.

Circular amputations give cicatrices which have all defects: seat, form, and adherence, and afford deplorable results. A number of such stumps cannot be fitted with artificial limbs, and they require 1 or 2 reamputations. Although a posterior flap may leave a stump a little too large it can be reduced by compression. An anterior flap or a combination of 2 flaps should be preferred; an external flap gives acceptable cicatrices.

Leg amputations immediately below the articulation give good general results. All leg amputations should give a cicatrix that will allow for a point of support on the stump directly or on the tibial notches, and should be performed as low as possible.

As shown by radiographs, the fibula is cut much too low, far below the tibia. High sectioning of the fibula is advisable. When the amputation is to be done less than 8 cm. from the knee, it is best to cut the bones higher than lower. Very high cutting, even in the tuberosity of the tibia, gives excellent results. In all such amputations it is advisable to provide for the perfect mobility of the knee, and to direct the cicatrization of the soft parts by elastic molds or by traction.

Tibiotarsal disarticulation, with the cutting of the malleoli as well as the intra-malleolar amputation, gives good results. Subastragalus amputation gives good results. Subastragalus disarticulation, the osteoplastic amputation of the calcaneus, and the Syme operation are recommended. They all permit the ready fitting of artificial appliances which the stump bears without trouble.

In amputating the leg in the middle third, the writer makes a long anterior flap, in order that the scar may be placed posteriorly. The deep fascia is included in making this flap, being dissected back at least 3 cm. beyond the point where the tibia is to be divided. The posterior flap is short and is dissected free for only a short distance; from its edge the skin and fat are dissected downward and a flap of fascia freed, of sufficient length to turn upward over the cut end of the stump. The muscles are divided 2 or 3 cm. below the point at which the tibia is to be amputated. Later the entire mass of muscle is bound together with 1 strong purse-string chromic suture which crosses over the anterior beveled portion of the tibia, or additional sutures when needed. The muscles are left long enough to be slightly longer than the bone when the purse-string is drawn. Muscle flaps are not made. The posterior fascial flap is turned forward and sutured over the end of the stump. T. G. Orr (*Jour. Kansas Med. Soc.*, Jan., 1922).

On the basis of war experience, the writer recommends early weight-bearing after amputations of the lower limbs. An apparatus is used consisting of a socket moulded to the stump and a skeleton frame which transmits the body weight to the ground, chiefly from the bony prominences. Part of the weight is borne by the soft parts, but always in such a manner as to relieve the wound of pressure, the lower end of the socket being left open for this purpose. The socket may be made of papier-mâché, leather, or plaster-of-Paris; the frame, usually of wood or light iron. Early weight-bearing, he contends, promotes healing by improving circulation, favors separation and discharge of sequestra, hastens stump shrinkage and prevents muscle atrophy and contractures, improves the morale, and greatly shortens the period until the permanent artificial limb can be fitted. P. D. Wilson (*Jour. Bone and Joint Surg.*, Apr., 1922).

War experience showed that certain forms of amputations described in text-

books were not actually suitable for practical purposes. The writer refers to what he considers the almost complete lack of utility of the Lisfranc, Chopart, Roux, Farabeuf and Teale operations, and the fact that in the Stokes and Gritti operations the retention of the patella proves a handicap to the limb maker. Syme's operation is improved by dividing the tibia and fibula at a higher level. Amputations through the knee joint are generally considered undesirable, and amputation at the hip is best performed with the skin flaps cut very short and the femoral head left behind in the acetabulum. Operations less than 3 inches above or below the knee or elbow joints are avoided. Corner is quoted as specifying the following amputations as remaining available for use in the lower extremity: (1) Amputation of the toes; (2) Syme's amputation; (3) leg amputation with skin flaps; (4) thigh amputation with long anterior and short posterior flaps; (5) amputation through the neck of the femur with skin flaps. For use in the upper extremity there remain: (1) Amputation of the fingers; (2) forearm amputation with equal skin flaps; (3) circular amputation of the upper arm; (4) Spence's amputation at the shoulder. The writer endorses the form of amputation of the leg recommended by Orr [see above] for cases with severe injuries or advanced disease where Syme's operation cannot be performed. Sir William I. de C. Wheeler (*Surg., Gyn. and Obst.*, July, 1924).

KINEPLASTIC AMPUTATIONS.

The World War greatly modified the attitude of surgeons in respect to the indications for amputations, owing mainly to the advances in plastic surgery. As emphasized by J. P. Warbasse (*Amer. Jour. of Surgery*, June, 1919) the advancements of plastic surgery have made new conceptions possible. Moreover, amputations can no longer be reduced to a matter of rules. Rare judgment is required in determining when, how or where to amputate, with the question "Is amputation required at all" as the predominant one. Once the general question determined, a plastic operation

should be preferred to lopping off a limb. Warbasse urges, as a conclusion taught by the war, that "*if there is living tissue beyond the proposed place of amputation, the necessity for the operation should be questioned,*" while the possibility of plastic surgery is now so great that before operating the surgeon should ask himself: "*Can I not excise the diseased part and supply the deficiency by grafting?*" Bones, skin, muscle, tendons, fascia, blood-vessels, nerves and joints are all capable of restoration and grafting. Further: "It should be borne in mind that when a limb is amputated for disease other than gangrene, the blood supply is usually more than adequate to nourish the stump. It is adapted to nourish not only the stump but all of that part beyond which has been removed. . . . To save as much tissue as possible is usually a good rule to follow. . . . The higher the operation the greater the shock. . . . The surgeon should ever have in mind the lessons to be found in plastic surgery and the grafting of tissues, and make his own variations to suit the circumstances of each individual case and his own skill."

History and Definition.—Kineplastic amputations were first described and proposed by Giuliano Vanghetti, an Italian practitioner, in 1896 under the name of **cinematic amputation**. Not being a surgical specialist, his views attracted but little attention from European and American surgeons, and the number of kineplastic amputations performed before the World War hardly exceeded twenty. Yet Bernard (*Progrès méd.*, Oct. 19, 1918) already declared that "it ranks among the greatest discoveries of orthopedic surgery," and that "it should be accepted with entire confidence and applied on a large scale to restore the functional use of limbs to the maimed."

The main aim is to utilize stumps which hitherto were deemed useless,—the carpal stumps, the very short forearm stumps, or disarticulation stumps, for example. Thus, after preparing suitable points of attachment, the kineplastic surgeon will spare, for instance, the deltoid and pectoralis major in a shoulder disarticulation, cover these muscles with skin, and endow otherwise useless stumps with useful motion.

Vanghetti has also given the names

cinematic plastics or **cinematics** to plastic operations that tend to economize, restore, or substitute muscular masses, in order to endow an artificial limb with voluntary motion. He had found that the muscles of an amputated member, when properly covered with skin and protected from retraction, could preserve their function.

General Technique.—All movable structure utilized in the reparative process, muscle tendon, etc., is termed a *plastic motor*. Its use is based on the following principles: In an amputation or disarticulation, the tendon and muscles, if protected with skin and supplied with vessels, nerves, etc., can generally be used if it is possible to provide a suitable point of attachment, similarly protected. This can be carried out either at the time of the amputation, or on healed stumps. The most commonly employed plastic motors are the *peg* (clava), the *loop* (ansa), the *knob*, and the *loop knob*. While the two first terms are self-explanatory, the "knob" is a thickened mass formed on the extremity of muscles, tendons, or aponeuroses and upon which some fixture or ring may be attached to exercise traction upon the prosthetic apparatus.

A plastic motor may be terminal, lateral or extra-segmental in its relations to the stump and its attachment thereto. Again, plastic motors may be unimotor or plurimotor. Thus, if there are two muscles with the possibility of reciprocal antagonistic actions united in a loop or knob, a double alternative movement may be communicated to the prosthetic apparatus from a single point of attachment. Vanghetti regards the alternating tendon and aponeurotic loop as the ideal motor. Again, a loop formed of two smaller alternating loops, interlocking like the links of a chain, may be able to impart three sets of movements to the prosthesis by the four muscles and three points of connection.

As emphasized by V. Putti (*Lancet*, June 8, 1918), there must be preserved the greatest possible amount of bone, as well as the motor masses and integument. Skin flaps, muscular insertions, various bony and tendinous fragments which would seem utterly superfluous under ordinary circumstances for the preparation of ordinary stumps are to be considered of the

greatest value in kineplastics. Retraction of the softer tissues must be guarded against, so that a later application of the principle may be successfully carried out.

A motor flap must (1) possess every requisite for withstanding a firm, resisting and painless grip, and also a traction that sometimes attains a high degree; and (2) it must be provided with a sufficient amount of functional muscular tissue to fulfill the task demanded of it. The flap must be covered with skin in perfect condition, well nourished, and provided with a normal degree of sensibility. It must also be of suitable size for the fastening of the necessary hooks, rings, or rods. As the tendon is the element best adapted for transmission of the muscular contractions, it must be largely used for the formation of the terminal motor flaps; or, by tunnelizing the muscular masses, extraterminal motors may be formed.

In order to supply such materials as may be missing *in loco*, recourse may be had to the numerous methods of transplantation of skin, muscle, aponeurosis, or bone. Arthroplastics, with interposition of aponeurotic flaps, may render stiff and ankylosed stumps usable. The difficult prosthetic problem of gaining power over the knee-joint has been solved by successful kinematization of the quadriceps; also the carpal stumps, the very short forearm stumps, and the disarticulation stumps are capable of good functional movements.

The action of the flexor and extensor muscles of the forearm may be transmitted to the artificial limb by means of metal rings covered with vulcanized rubber. These are placed at the ends of finger-like motor flaps and gradually tightened until held firmly, the fingers of the artificial hand being attached. In another type of motor flap the tendons of the flexor and extensor muscles are brought together in such a manner as to form a ring or loop which is covered with skin, through which a rod is placed to be attached to the artificial limb. If the motor flap is well placed, if the skin that covers it is healthy, and if the wounds are absolutely healed, neither the rings nor the rod cause the slightest pain nor do the least harm. The ring is supplied with a screw by which the patient may regulate the pressure on

his finger-like motor flap. The rod should be removed at least once in twenty-four hours in order to clean it with alcohol and lubricate it with vaseline.

Usually it is better to prepare a loop with the tendons of 2 powerful muscles and resect the others at the level of section of the bone than, *e.g.*, to attempt in a forearm amputation to unite all the flexor tendons with the extensors; this makes it easier to obtain a proper skin covering of the loop. While it is possible to change the functions of muscles by motor education, it is always best to use as motor a muscle having naturally the same function as that required of it in the prosthesis. The value of a few weeks of exercising of the muscles in increasing the amplitude and force of motion with the apparatus was plainly seen in several of the writer's cases. Some little meditation and recollection on the part of the patient is required to recover power over muscles long unused when kinematization of an old stump is attempted. Massage and electricity are employed in the immediate postoperative treatment. Favorable functional results were obtained in amputations of the arm, forearm and leg. G. Bosch Arana (*Presse méd.*, Dec. 12, 1923).

The sensibility and muscle sense of the flap when first made is greatly impaired, but improves upon use until even a keener sense than normal is developed. The patients best adapted for this class of procedure are those between 20 and 30 years of age, who are mentally keen and adapt themselves to their newly formed members. Diligent training is required to cultivate the muscles to take up their new work accurately and untiringly.

In the *Putti forceps* or *radioulnar cleft* method of kineplastic amputation, after removal of the hand and a portion of the forearm, a long cleft in the remaining forearm is made by which objects, such as a spoon, can be grasped, and muscular power exerted by rotation of the parts. Putti (*Chir. d. Org. di Mov.*, Jan., 1923), among others, reported the case of a young woman whose forearm had been amputated on account of tuberculous disease and in whom

the method gave results exceeding anticipations. In many such cases the force available is sufficient to operate the fingers of an artificial hand.

Report of 3 cases of arm amputation provided with prostheses for two-motor stumps, made from the biceps and triceps muscles. Skin bridges, anterior and posterior, are established—a proceeding to which the arm is better adapted than the forearm, as large, wide tunnels can be prepared. All 3 patients are going about their usual business. These patients can, with their artificial arm, grasp any object of average weight, lift it to the mouth or either side of the head, bend the arm or extend it, and go through the movements of pronation or supination of the hand. In all of these attitudes the artificial fingers can take hold of an object or lay it down at will through the kineplastic arm motors. G. Bosch Arana (Surg., Gyn. and Obst., Mar., 1926). S.

RESORCIN.—Resorcin (*Resorcinol*, U. S. P.; metadihydroxybenzene) is a diatomic phenol obtained from metabenzene disulphonate by sodium hydrate with heat. It is also produced from different resins and from umbelliferous gum-resins on fusion with caustic potash. It is isomeric with pyrocatechin hydroquinone. It occurs in small, colorless, rhombic prisms, or plates, which turn reddish on exposure; is neutral in reaction; has a sweetish, unpleasant taste, and a peculiar but faint odor, which resembles that of carbolic acid.

The substances incompatible with resorcinol are: Acetanilid, albumin, alkalies, antipyrin, camphor, ferric chloride, menthol, spirit of ethyl nitrite, and urethane.

PREPARATIONS AND DOSE.—

One Gm. is soluble in 0.9 c.c. of water or alcohol. It dissolves in ether and in glycerin, but is only slightly soluble in chloroform or in carbon disulphide. The best vehicles for medicinal purposes are alcohol, glycerin, and syrup of orange. Resorcin has antipyretic, antiseptic, antispasmodic, antiemetic, and analgesic properties. It is given in doses of from 1 to 10 grains (0.06 to 0.6 Gm.), several times a day; as an anti-

pyretic, as much as 15 to 30 grains (1 to 2 Gm.) has been used.

Resorcin is, in addition, sometimes used externally in a 1 to 5 per cent. solution or ointment.

POISONING BY RESORCIN.—In large doses (60 grains—4 Gm.), resorcin causes a lowering of the temperature (which persists for two or three hours), nausea, oppression, languor, salivation, and profuse sweating. In larger doses it is followed by cerebral symptoms, such as giddiness, tingling, deafness, confused vision, tremor, clonic convulsions, and unconsciousness; the tongue is dry, the teeth clenched, the pupils normal, the temperature low, and the urine black (hemoglobinuria). Death takes place from respiratory and cardiac paralysis. Death has occurred in children from lavage of the stomach with a 3 per cent. solution. Schwabe reported a case in a child in which 15 grains in an enema produced alarming symptoms. In the adult recovery has followed the ingestion of 2 drams.

Cases have been reported where poisoning occurred by absorption through the skin. When large areas of broken or denuded skin are present, its use should be entirely avoided, especially in weak individuals and in small children.

Treatment of Poisoning by Resorcin.—Evacuation and lavage of the stomach are indicated. The administration of albumin, diffusible stimulants, and diuretics may be supplemented by the application of external warmth to the trunk and extremities. The use of atropine, strychnine, adrenalin or ether hypodermically will tend to counteract the paralyzing effect of resorcin upon the heart and on the respiration.

When the drug is used continuously for a long time, it is perhaps wise to prescribe, internally, hydrochloric acid, which Unna recommended as the best antidote in phenol poisoning.

THERAPEUTICS.—Resorcin has been employed in doses of from 1 to 2½ grains (0.06 to 0.16 Gm.), in solution or powder, repeated every hour or two, for the relief of vomiting and seasickness. In similar doses it has been found of value in dyspepsia, chronic gastric catarrh, diarrhea, cholera nostras (cholera morbus),

and in **enteritis**. It is also serviceable in **enterocolitis** or **cholera infantum**. It relieves pain and checks hemorrhage from **gastric ulcers**. Gastralgia is relieved by this remedy.

Resorcin has been useful in **pertussis** and **hay fever**, in the form of a spray from a 2 per cent. solution and internally in doses of 10 drops of the same solution.

In a 2 per cent. solution, it is a beneficial application to **tuberculous lesions of the larynx**, and in **purulent and ulcerative affections of the throat and nose**; in the nose the solution should not be stronger than 1 per cent. In **diphtheria** resorcin is a valuable topical remedy. In **asthma** and **emphysema** resorcin has been given in doses of from 5 to 15 grains (0.3 to 1 Gm.).

Resorcin has been used topically in **skin affections of a subacute or chronic character**, in solution or ointment varying in strength from 1 to 10 per cent. or more. It should be borne in mind that weak solutions (1 to 3 per cent.) harden the skin, while stronger ones (10 to 50 per cent.) macerate and destroy it.

In **chancroids**, **painful ulcers**, and **suppurating and sloughing wounds** resorcin may be used externally in solution or ointment (1 to 10 per cent.), in injection or spray. Absorbent cotton and gauze may be medicated with resorcin for **surgical dressings**.

In **aphthæ**, **stomatitis**, and **thrush**, a 1 or 2 per cent. watery solution of resorcin is an efficient application. W.

REST CURE.—DEFINITION.—

The Weir Mitchell treatment by rest, isolation, and forced feeding is a radical and rational measure combining the fundamental desiderata for restoring exhaustion states.

[The system, viewed as a whole, is applicable to the repair of pronounced degrees of depleted vitality caused by a large variety of causal agencies. A personal experience of many years as assistant and later chief of clinic to Weir Mitchell, enables me to speak with confidence and knowledge of his methods and results. Doubtless his extraordinary personality, penetration, judgment, and clinical skill

all contributed to his brilliant successes. He devised and used it in combination with remedial agencies which in many instances proved the point of departure toward recovery of a multitude of heretofore baffling or incurable conditions.

The utility of rest treatment is to be evaluated not so much upon the reasonableness of mere rest, isolation and forced feeding as upon collateral factors differing with each case. These are ever the same in principle, but vary with circumstances under which the process is begun, and the amount of authority permitted the physician for the exercise of control over the patient. Above all, final success cannot be expected unless caution is exercised in slowly but judiciously restoring customary activities and responsibilities. J. MADISON TAYLOR.]

Among the factors in a full course of rest treatment are all those agencies which contribute to what may be termed reconstructive personal hygiene. This includes full physical and mental relaxation, all those measures of revised life and conduct which make for improved nutrition and elimination, and, finally, education in constructive activities.

The process is one of education, training and retraining of the body and mind. Hence, in the training of the body attention is given to various organs and systems, *e.g.*, the respiratory, the digestive, the sense organs, the skin, the skeletal structures, joints, etc. Many individuals, as clinicians well know, are ignorant of the essential principles of mental and bodily hygiene. This is just as true of those amply supplied with luxuries as those who are deprived of them.

Discipline, concrete guidance, enforced attention upon the need of normal function and its regulation can be especially well supplied while the individual is removed from dis-

tractions of every-day life, personal demands and habits.

[Isolation and enforced submission provide the physician advantageous opportunities for thoroughly exploring each and every point and symptom, whether conscious or submerged, and for estimating their significance and limitations. Many of the sensory distresses are evanescent and negligible; others are of grave import, though suppressed or below the threshold of consciousness. Among the manifold phenomena deserving critical attention are: abnormal subjective and objective sensations; paresthesias, of pressure, constriction, numbness, tingling; of varieties of headaches, backaches; sense-organ anomalies, visual, auditory, tactile, and olfactory; spinal and other tender-nesses, backaches, derangements of secretory and sexual organs; abnormalities of motion, direction, of power or weakness, local or general, cardiovascular, renal, and endless others.

Physicians often urge objections to the rest treatment which are erroneous or fanciful; or cite instances where no good was accomplished by it, or where actual harm is charged. This opposition is due to insufficient knowledge of the true purposes and procedures, or to a lack of persistence in enforcing them. Where suitable cases present, and it is decided to employ the measure, there are usually strong objections urged by the patient against such long and radical procedures. In consequence of this the temptation is for the medical adviser to so modify essential steps, in the endeavor to please patient and family, that it fails to supply definite needs, which may be clear to the physician, but not to the ailing person. Where protracted disabilities have induced that mental confusion and misinterpretation of symptoms, which inevitably follow from hope long deferred, much suffering and disturbance of customary habits, then the one quality a physician must display is decision, determining what is best and unflinchingly pursuing his plans to a successful issue. He should decide and execute.

There should be no greater difficulty in pursuing a course of rest treatment than

in any other logical or rational measure. One can always accomplish by it far more prompt, uniform and permanent results, than by a course at some foreign spa or by haphazard travels, and it is more creditable to the physician. J. MADISON TAYLOR.]

The chief features of rest treatment submitted here are from the standpoint of one long familiar with its features and possibilities, and should furnish the general practitioner with confidence in rendering more available this excellent form of systematic therapeutics.

Accuracy of diagnosis is requisite in dealing with any derangement; it is pre-eminently necessary that the physician shall have adequate time and opportunity to study those complex problems involved in the neuropathies, neurasthenias and psychoneuroses. In by far the largest proportion of those who have suffered from protracted ailments or illnesses, there has arisen an involved mental state compounded of real and unreal phenomena. The solution can then only be reached by a nice degree of awareness in which psychology is on a par with the utmost scientific resources of purely medicinal measures.

The most efficacious means of securing a state of physiologic receptivity, both for psychic and physical adjustment, is to **place the sufferer at absolute rest, to seclude from all outside influences, family, mail, news, and the like.** Under no consideration should this be attempted in the patient's own home if psychopathy be a pronounced feature. Mere physical rest, moreover, is frequently not enough. Hence Weir Mitchell initiated and developed a systematic method of what he describes as "robbing rest of its evils;" nay,

more, to so enhance its value by suitable coefficients as to bring about permanent betterments. Rest is an obstacle to further improvement if continued beyond its useful period. Excessive rest leads to degeneration of tissues; not to restitution.

The central point of the rest treatment is the analysis of morbid phenomena, physical and mental, reinforced by dominant, educative suggestion, "moral orthopedia" (Dubois), a wise training of the patient, whose salient characteristics are maladaptation between his own consciousness and environment and impairment in powers of right thinking, willing, feeling, and doing.

Not all cases of psychopathy or psychasthenia need rest treatment, but isolation, like "moving the previous question," cuts off debate, places the individual in the "hypnotoidal state," which, by eliminating the life of customary relationships, enhances receptivity not only of mind but of body.

By absolute rest, isolation, and forced and regulated feeding, one can best plow and harrow the ground, enrich the soil, and then proceed to sow the seeds of right thinking, feeling, willing, and acting. This is the key to the situation: to place the psychically entangled individual, whose central defect is weakness, or exhaustion, or both, in the best possible attitude for educative suggestion and bodily repair. Time, abundant time, is required, with ample opportunity to slowly but surely conserve the budding growths of vigor and wholesome-mindedness.

He who gets well the soonest and remains permanently cured is always the most obedient, the most coadju-

vant. When dissociation or disintegration of personality is re-disintegrated, the psychic instability corrected, the infinite changeability mitigated, the fundamental physiologic functions restored to a normal rhythm, one can then proceed confidently to overcome the abnormal fatigability and other neurasthenic substrata. If the getting of a patient to bed is not easy, as often happens, the resumption of activities after some weeks is no light problem; that is, to do so safely and permanently. To restore is only the beginning; to reinstate volition, to make sure of progressive efficiency, is the real object.

Among the chief agencies of the after-cure in rest treatment are motor education and persistence in right doing. Both motor and psychic right direction in the months and years to come is of more real importance than even the preliminary, though radical measures. Here the counsellor shall stand or fall, according to his judgment, his personality, his persistence.

OUTLINE OF THE DAILY ROUTINE.—The patient who requires the rest treatment is no longer in a position to drive his business, whatever it may be, but, being unable to do so, the business drives him. So long as the ship is under way and proceeding by its ordinary motor forces, it can be steered satisfactorily. If the driving forces become too strong so that the capacity for guidance is lost, the ship can no longer be accurately directed, becomes buffeted and in danger from misdirection. Again, unless the various measures follow in regular progression the same results cannot be expected, because, if for no other reason, it is an

expensive process, on account of the time lost.

The best results are had from modeling the day much after that of an ordinary working person. Measures should begin early in the morning. The patient usually needs to be aroused at about 7 o'clock or even earlier in summer weather. With the first peep of dawn, if the patient is awake, or by 7 o'clock at the latest, when, if asleep, the patient should be awakened, the nurse should bring some hot drink to the bedside. A small cup of cocoa is in some respects the best; or hot milk or weak coffee or tea. Cocoa is useful for those who need to be fattened; tea better for those who are already burdened with soft flesh. The hot drink acts both as a food, enabling the patient to bear the fatigues of the subsequent bathing and toilette, and also, on account of the heat, as an admirable heart stimulant. Indeed, a cup of hot water in the morning is a far more competent "eye-opener" than any combination of alcohol. This can be proven in the case of men accustomed to take much tipple, who often become more enamored of a cup of hot water than of any concoction emanating from a bar.

After a cup of hot fluid, the nurse administers a brisk dry rub or a bath. A sponge bath is best as cool as possible; to those who can endure it, it should be cold. It is better also for containing some stimulating property, as salt. The patient lying between blankets to prevent all chill, the nurse takes one limb at a time, bathes it gently, and afterward rubs the skin to a good pink glow. As each part is disposed of it is carefully protected by a blanket, and the next ap-

proached. This occupies probably half an hour; then a rearrangement of clothing, and the subject is made comfortable for the day.

About 8 o'clock comes an ample breakfast, which will be found in no way interfered with by the small cup of drink earlier. After breakfast an hour's rest follows while the nurse attends to duties elsewhere, and the patient is not allowed to be disturbed. The second meal is given about 1 o'clock, and takes the form of a liberal dinner. At 6 o'clock comes the last meal, a fairly substantial supper. After each meal a period of an hour should elapse in which the patient is to be kept entirely quiet. Between breakfast and dinner, about half-past 10, fluid food is again given—milk, broth, or soup. In some cases this is repeated between dinner and supper; and at 9 o'clock, or before the final tucking in for the night, it is customary to give again a glass of milk, preferably warmed.

The massage should come either in the morning, just before the milk, or in the afternoon, midway between the meals. If electricity be used at all, it may be applied in the course of the half of the day not occupied by massage.

On going to bed at night there is frequently given a dry skin rub with a coarse towel, or, if salt is not used in the water in the morning bath, with what is called a salt towel. This consists of a coarse cloth dipped in a strong salt solution and dried; it is stimulating to a flabby skin. Massage is best used in the morning, and is followed by a glass of milk, the patient again lying quiet for an hour. Electricity is best given in the afternoon, and need not be followed by

anything except, perhaps, cheerful conversation. Indeed, the physician's visit is most acceptable during the latter half of the day, when occupations are somewhat less systematic and the diurnal ebb and flow of vital forces are at their lowest. The patient is then most lonesome; thoughts dwell upon home and other emotional matters, so that the physician is welcomed in turning aside discomforting ideas. The electricity need not occupy more than half an hour, making an agreeable break in the day's work. This may be administered by a young physician trained for the purpose, or, in some instances, by the nurse; but it is oftentimes of distinct value to use a variety of personalities in performing these routine measures.

The daily evacuations should be sedulously regulated. It is well to follow the habits of each one as to customary time of the bowel movement. However, a full daily evacuation of the bowels should take place at some regular time, and the will of the individual should be trained to bring this inevitably to pass. The patient gets up for defecation. Slow-acting bowels act best in a stooping posture, squatting on the heels over a shallow vessel.

Not the least factor of value in this whole episode is **the establishment of thorough, systematic habits of body and mind.** At first there should be entire dependence upon the attendants; later, as active measures are instituted, the patient should be taught to direct her own volition in entering into the spirit of various measures; must soon or late depend upon herself to continue. Urination must be supervised, its quality and quantity

carefully noted; fixed times for the voidance of the urine are most useful.

Body temperature should be taken regularly, at least twice daily, to observe fluctuations and unknown tendencies. It will often be found about 100° F. (37.7° C.) for two or three days; then it may drop to sub-normal for a few days more, and finally become and remain normal.

DIET.—So well is the subject of dietetics now ventilated, that it is only necessary here to remark that while particularized dietetics is a most important factor in the treatment of exhaustion states, it is not so paramount as some have claimed. How one eats is often of greater significance than what. Mastication is of first importance; omitting to sip fluids is another. Motor power of the stomach is above biochemical regulation. Where the patient is undernourished full feeding, even forced feeding, is indicated. Milk and eggs, especially the raw yolk of eggs, should be administered between meals. Where there is obstinate dyspepsia, or, as occasionally happens, overweight, or hypernutrition, a course of skim milk in lessening amounts, after the method of Karrell, will prove of advantage to reduce flesh, relieve vascular tension, and cure many functional derangements. This consists of eight ounces of skim milk, sipped from a spoon, every three hours, each day lessening by one ounce, till only two are given, then increasing to the first amount and gradually adding some stewed fruit and bread, then in about three or four weeks getting back through a simplified, to a more complex, and finally to a normal dietary. A period of complete starvation any time for a

day or many days is an excellent device to correct vitiated digestive states, gouty phenomena, hypochondriasis, or to restore lost appetite. While a person is at absolute rest many such radical measures can be employed more safely and successfully than for one who is up and about. Moreover, hyperalimentation can then be pushed to an extraordinary degree. Full and overfeeding to the limit of capacity is paramount to make up for lost nutritive balance.

Hastily accumulated fat is readily lost. So are other rapidly stored cells in danger of swift escape when activities are resumed. Hence the necessity for those rational auxiliary measures, massage and graduated forms of motor education not only to hold what is gained, but to render it available, useful, potential. Nutritional errors met are largely due to impairment of innervation from exhaustion; hence the need of rest which usually is in itself adequate to restore digestive tone.

MEDICINES.—A good clinician can be safely entrusted with the administration of needful drugs, and he is the more successful when working with such tools as are familiar. Few are needed; this elaborate process of nutritional repair renders them relatively unnecessary.

In this connection it is well to refer to the suggestive summarization of the pathology of neurasthenia as presented by Sajous. Neurasthenia is recognized to be a vasomotor neurosis, the prominent feature of which is relaxation of all arteries. This he explains as due mainly to exhaustion of the sympathetic center and the resulting relaxation and loss of propulsive power of the arterioles. The tissues

thus become imperfectly oxygenized and nourished; hence follow the mental torpor, habitual fatigue, adynamia, and gastrointestinal atony. Various clinical classifications are suggested, describing varieties of functional disturbance; but whatever the multitudinous symptoms, certain features are common to all which depend on varying degrees of hypothyroidism. Hence he recommends small doses of desiccated thyroid, and usually in combination with small doses of strychnia and full amounts of an assimilable form of iron, such as Blaud's pill. These produce an improved tone and nutritional power of the blood. The thyroid preparation is assisted by strychnia, which, by exciting the adrenal and vasomotor centers, enhances general oxidation and the vascular tone. The sympathetic center and muscular layers of the arterioles are also better nourished, and they recover tone from another direction, a most important factor in systematic repair.

MASSAGE, PASSIVE AND ACTIVE; EDUCATIONAL MOVEMENTS.—The efficacy of massage is so great that it is surprising to hear the measure occasionally belittled. Few clinicians practically study the subject and hence are victimized by inferior operators who, failing to get adequate guidance and direction, produce valueless or even hurtful effects. Suffice it is to say that while aiming to improve both psychical and physical conditions, we have a powerful ally in judicious manual methods of awakening the dormant kinesthetic centers by motor and sensory stimulation. It is most necessary, in treating the victims of disuse or misuse of bodily and mental function, to re-

store normality in the realm of both correct sensation and motion. Receptive centers have here become dormant, vitiated, or exhausted; the cortical sensory and motor centers need to be brought into normal relation with the rest of the controlling centers, hence with the whole field of consciousness.

The sensations and ideas of motion are functions of the convolutions back of the Rolandic fissure. In normal volition these convolutions are first excited by association impulses from other centers, and then directly or indirectly by association impulses which they arouse in corresponding motor centers in the precentral convolutions.

Furthermore, above and beyond effects to be achieved by general massage and regulated (passive and active) movements, there is a vast field of potentiality in judicious nerve-pressure, direct, distributed and alternated, whereby extraordinary effects can be wrought in regulating vasomotor reflexes; hence on blood distribution, etc. This last is rightly the province of the skilled physician and should be performed by him, or, at least, under his direct supervision.

The enforced inaction continued through many weeks would produce objectionable effects unless something definite were done to rob rest of certain evils. The most important agency for this is to employ regularly a generalized massage or manipulation of the muscles and tissues, by which they can be maintained in a healthy condition until the period arrives when active muscular movements can be resumed. If this were not done, as a rule there would be too great a gain in flesh, chiefly fat,

but all the cellular accumulation would be loosely organized and unstable. An index of the good which the rest treatment is accomplishing is a normal progress in the accumulation of weight which should be not too swift. It is an axiom that poor massage is better than none at all, but by this is meant lack of skill in the manipulations failing to bring about the best results; it does not mean overzealous or forceful manipulations, which may, and sometimes do, result in harm. A fair index of the value of the massage is the equation between the amount of food taken and quality of the digestion. It should produce a proper amount of tissue change and waste by which the solidity of the tissue is improved. In my opinion it is impossible to do without any massage and get satisfactory results. Physicians will soon realize that one of the largest factors in therapeutics is mechanical excitation of nervous control mechanisms.

It may be we shall always employ for the routine procedure of passive exercise a special expert in massage and remedial movements; but in order to get best results, the medical adviser must himself clearly understand his physiology, and the enormous possibilities of mechanical excitation of centers.

It is well to bear in mind also, that for very feeble patients massage is capable of producing fatiguing effects of a somewhat serious nature, even if the methods employed are excellent. When it is held in mind that undue pressure upon certain areas produce powerful effects upon arteriomotor innervation the physician at least must be on his guard to warn the operator how to avoid this.

Massage as used in routine procedures is usually given in the middle of the forenoon, and the electricity in the middle of the afternoon, or this may be reversed. At first the time occupied should not be over twenty or thirty minutes and by a slow, gentle effleurage with passive movements of the joints. At first the manipulations should be stroking, then kneading in character, and gradually increased until the upper tissues are made to act upon the lower, until the deepest tissues are reached, pulled, and stretched. As the patient becomes accustomed to this, in a week or ten days deep kneading is used, increasing the force until all the muscle-masses are squeezed and relaxed, and the long tendons pulled upon and rotated without pain. This should always result in a feeling of comfort and satisfaction akin to that which follows active exercise. Massage under these circumstances is chiefly for the purpose of affording a passive form of exercise which the condition of the patient would not warrant, and it is generally accepted that a full hour's massage treatment is equivalent to an active walk of five miles. This brings no strain upon the heart or the central control mechanism and hence does not fatigue either the circulation or the attention. As the treatment progresses the massage proper can be more quickly and forcefully accomplished, and passive movements of the limbs are more thoroughly used until considerable force is exerted on the tendons and ligaments by which the joints, both large and small, are kept in full elasticity and tone.

Toward the end of the treatment, it may be six to ten weeks, accord-

ing to the strength of the patient, forceful resisting movements are practised. By these the entire motor mechanism is brought into play and physical vigor is oftentimes made to become as good as it was under normal conditions. Then this is supplemented by fuller regulated activities until it is not rare to find that a patient subjected to this routine can be brought to a degree of physical efficiency which she has never expected to enjoy. More and better effects can be wrought upon bodily powers by these systematized remedial movements, if the patient judiciously cooperates, than can be accomplished by any amount of undirected free exercises.

Certain precautions must be maintained. The tissue should become thoroughly relaxed while passive movements are employed. During active processes fullest accuracy and force should be elicited in not only posturing movements, but especially during resistance. Resistance movements are best slow, but of increasing force to a point where movement is completed and the limb held in utmost tension capable for a few seconds. Extensor movements in the arms are more important than the flexor, because most common daily acts are flexor movements, and an excess of extensor movements is needed to acquire free muscular power. Only through thoroughly directed and accurate muscular actions can the circulatory machinery be kept at its full efficiency. Only through circulatory activity can nutrition be fully maintained. Only through fullest nutritive interchanges can exhausted nerve-centers regain tone.

During massage, relaxation of su-

perforated capillaries and opening of sweat-glands occur. This relaxation is followed by surface moisture which, by evaporation, induces escape of heat, producing surface chill, and ill-effects follow to be guarded against by a careful protection of the part. Each part should be wrapped after being treated, on woolen stockings slipped over legs and arms. Rest for a full hour follows.

For those not fully strong a period of rest should supplement that of activity, and for the same length of time. To sum up: The procedures of massage, passive exercises, resistance movements and active movements, should be systematically increased in proportion to the strength of the individual. Surprising results will then follow.

THE NURSE.—Next to wisdom and tact in the physician, is suitability of the nurse. Not only must she qualify technically, but intellectually, and in the realm of common sense. Her business is to maintain a symmetrical, consistent, daily routine, and keep the patient busy all the time, supplying just enough conversation, but not too much information or explanation. Patients often remark that the rest treatment was one of the busiest periods of their lives. All this keeping busy is essential. The patient is, and should be, passive, in extreme cases absolutely so, all "doings" being performed by others. At first the nurse actually places food in the patient's mouth. Conversation had best be of the simplest. Part, and not the least part, of the cure is selection of judicious topics; their character and manner of presentation is the duty of the nurse from hints supplied by the physician.

Old lines of thought need to be firmly set aside and new points of view presented. Suggestive education is paramount. In this the nurse is the constant, if not the chief, agent.

Upon the nurse depends success or failure. She must be the right hand of the physician; to her must be explained precisely what is expected. For her must be outlined the whole status of the case and the peculiarities of the individual. She should be selected by the physician and never by the patient. The nurse that brings a patient from a distance, or has been in previous attendance, if a stranger to the physician, is valueless; at least, if the case be difficult psychically. No amateur nurse, however wise and capable, can be depended upon. Relatives and friends are useless and worse than useless. The nurse should be a stranger to the patient and, if possible, have had some experience in similar cases. However, a young, intelligent and enthusiastic nurse can be taught readily to become invaluable; an old experienced nurse, whose gravity has matured and whose enthusiasms have cooled, is not so good. The neurasthenic, or hysteric, or hypochondriac, or that complex blend which usually demands this sort of care, will inevitably try the patience of a very angel.

The nurse must occasionally be changed, but not too readily, because it is a hard matter to judge fairly upon the patient's representations. If, however, complaints are seemingly well founded, this may be necessary. It should not be done too often or worse will follow. It is not necessary that nurse and patient have similar tastes and interests; it is bet-

ter they should differ in education, religion, or capabilities. It may be important to act upon the patient through the nurse by marking out a line of fit conversation which can only thus be carried out, and may stimulate other thoughts, and to better conclusions. The nurse should be warned against discussing symptoms or the wisdom of certain procedures. She must be sympathetic, but should not sympathize.

When the physician has made his visit, it is well for the nurse to make her report before the patient and then to leave the room. Thus the patient may unburden herself of any matters without an audience other than her appointed confessor.

After completion of treatment it is customary to send the patient, with her nurse, to some pleasant place in the country, or quiet seaside or mountain resort and pursue an after-cure. Then the need of a wise nurse is often greater than before; her qualities are more critically tested. If she be refined, she should travel as a companion, and not be obviously a care-taker. If she has some artistic accomplishments, or abilities to ride or drive, she is thus of special companionability; familiarity with the various fields of sports is to be appreciated.

Sometimes nurses accompany patients in foreign countries and for long periods; then special qualifications are needed,—above all, self-reliance and generalship. It is often necessary to instruct a nurse to exhibit, after a time in a foreign country, a degree of helplessness which shall compel the patient to take charge as courier, and regain her own lost dominance. A patient who was

becoming very dependent upon her nurse, in all the attitudes of life, found herself in difficulties which proved to be most fortunate. Falling seriously ill, the patient had to look out for her, and this solicitude was the means of herself regaining certain qualities which almost nothing else could have effected. It is a rule to change a nurse in about two or three months. Few can be trusted to remain longer. The reasons for this are manifold, as experience will show.

In some cases early, and in others late, the nurse is allowed to read from some interesting book, for a specified time, once or twice a day. The character of this reading should be carefully selected. The best is the simple mental pabula of childhood, as classical fairy tales and ancient romances. Many a patient has expressed satisfaction at the opportunity offered of renewing acquaintance with these delightful Old World romances.

CONVALESCENCE AND AFTER-CURES.—Lack of space forbids more than brief reference to what Dr. Mitchell always emphasized as the most important part of the rest treatment, viz., adequate control and supervision till the cure becomes permanent, or as nearly complete as under existing conditions could be achieved.

Rest treatment is a systematic process of regeneration or restitution, the aim being to not only restore health, efficiency, self-control, physical, mental, and moral equipoise, but also to retain all that should be gained till the end of life.

Hence, consistency of measures, as has been so often repeated, is of paramount necessity. The means

which he employed embraced all those agencies which could be elicited to impress the consciousness of the patient with his or her highest duties to self. It is also a process of training or retraining, of dominant guidance, of securing full co-operation after having raised the index of efficiency through awakening sense of duty to highest standards of conduct.

Dr. Mitchell was peculiarly fitted to arouse ambition, to conserve personality as well as to reconstruct and equip the body for life's work, duties, and satisfactions.

The first steps after absolute supineness are those of getting the patient upon her feet. To be sure some rising and moving about are usually encouraged during the rest; often it is unwise to do so. Hence, getting up requires much urging, or cajoling, or domination. Many persons fiercely resent being disturbed, so serenely comfortable have they become, so resigned to complete dependence. The most difficult problems are persons who were most rebellious against going to bed.

Sitting up is begun by ten-minute periods, first once a day, then twice, then adding five minutes till an hour and a half, then walking to and from a chair and increasing the distance of the chair from the bed. Finally, an outing is planned—a drive or short walk.

All this should be accurately outlined and strictly carried out. Any sort or kind of excuse may be offered to break routine. Tact in the nurse is a great help; she should co-operate in spirit and letter. After the patient has left immediate supervision, the nurse reports regularly and fully; later the patient writes also at speci-

fied periods of weeks or months, and especially after the nurse has gone. This period—the final severing of personal contact—taxes the diplomacy of the patient and adviser.

Here some of the most fatal blunders are made. Other, alien influences are encountered. Mischief-makers are peculiarly eager to overthrow wholesome routine and break in on consistent measures. During my period of service as confidential secretary many vividly interesting and exciting occurrences arose, forming materials for books on psychopathology and anomalous human documents.

Such experiences were invaluable clinically and saved my making many serious mistakes, medical, psychological and domestic. Errors in this stage of procedure often cause ill-deserved blame to fall on the physician.

Finally, how long does it take to restore an exhausted human being? They must be managed with rare acumen and supplied with radical conservative procedures, for so long a time as is needed for cellular restitution. This, by common experience, takes at least half or a third of the time consumed in producing the effects, seldom less than from one to three years; about two years, as a rule.

The channels of guiding force demand skillful re-education. Where serious vitiation has occurred, not only in the physical but also in the psychic habitudes, there is also the problem of mental readjustment, and this is not only the more difficult, but also the more protracted.

J. MADISON TAYLOR,
Philadelphia.

RESUSCITATION.—The respiratory process is often compromised or arrested by conditions which prevent the access of the oxygen of the air to the lungs: drowning, foreign bodies, throttling; irrespirable gases, such as illuminating gas, fire-damp, etc. Under these circumstances, artificial respiration is an extremely valuable procedure, when, of course, the cause of the asphyxiation has been removed. Foreign bodies interfering with respiration are sometimes difficult to reach, a laryngologist being often necessary; but frequently the object may be grasped by sweeping the lower pharynx with the index finger. The epiglottis can be raised by the same procedure. In drowned subjects, any water which has entered the lungs must be removed; the various methods available are described under "Drowning" in another volume.

TECHNIQUE.—The **Sylvester-Howard** method of artificial respiration is that now generally preferred. The patient's shoulders and chest are raised from the ground by placing a folded coat, a rolled blanket, or any other article at hand under the shoulders, the head being allowed to fall backward. If he is being anesthetized the patient is slid up on the table, the head allowed to hang partly over its edge, and the foot of the table raised. The physician, kneeling or standing at the patient's head and facing the latter, seizes his bent arms firmly at the elbows, and draws them outward and upward toward the head. This maneuver causes both the expansion of the chest, by raising its walls, and the entrance of air into the lungs. As it takes a second or two for the latter to become thoroughly filled, the arms are kept in the position mentioned that length of time. The elbows are then brought down again toward the chest, and, when the latter is reached, firm pressure is exerted (through the intermediary of the patient's elbows, of course) upon the ribs, so as to cause *these to sink in, thus compressing the lungs and expelling the air.* It is important in this connection, however, to have an assistant at the same time apply his hands over the lower ribs on each side and press them inward and upward, *i.e.,*

toward the diaphragm, thus further compressing the thorax, to force out the air. This complete cycle—expanding the chest and then compressing it—should be carried out deliberately and evenly about 16 to 18 times a minute—the normal respiratory rate.

This procedure is often successful in restoring life even when it has apparently been suspended some time; but it is important to persevere in the face of discouraging circumstances an hour or more. Slapping the patient's body or face with a towel wet in ice-water, or forcibly dilating the sphincter ani, sometimes hastens recovery by inducing sudden reflex inspiration.

Restoration of the respiratory function is indicated by a gradual disappearance of the pallor or lividity and of the cyanosis. With the return of color follow feeble gasps now and then, soon succeeded by stronger attempts at respiration with return of heart beat and pulse.

The **Schäfer method**, likewise a valuable method, is especially useful when the physician or operator is alone, because it enables him without assistance to exert considerable pressure upon the chest, to expel the air. Instead of being laid on his back, as in the foregoing procedure, the patient is laid in the prone position, *i.e.,* on his abdomen, the face being turned slightly to the side, and a folded garment or blanket is placed under his chest. The operator then kneels across or athwart the patient, facing his head, and applies his hands to the back, one on each side of the spinal column, spreading the fingers over the lower ribs. He now throws the weight of his body slowly upon the latter and the thorax, thus bringing about its contraction and expelling the air in the lungs. He then raises his body and relaxes the pressure, allowing the thorax to expand and to cause the air to enter the lungs. These two steps are executed repeatedly, with deliberation and regularity, 16 to 18 times a minute, as in the foregoing method.

The **Sylvester-Howard** method is preferable in that the stage of thoracic expansion is actively facilitated by raising the arms, whereas in the Schäfer method

this feature is left to the resiliency of the thorax. The chances of recovery may be greater, therefore, when the Sylvester-Howard method is employed. Moreover, the latter permits of the use of an auxiliary measure, *viz.*, the **Laborde tongue-traction method**, which consists in seizing the tip of the tongue with the napkin-covered fingers, and fully drawing out the organ, rhythmically, 16 times a minute. This procedure in itself, through excitation of the respiratory centers, is capable of restoring the breathing process in some cases, and thus constitutes a useful adjunct to artificial respiration. The **intravenous use of warm saline solution** (105° F.) with 20 minims of 1:1000 **adrenalin chloride** solution added drop by drop to the saline solution (by sticking the needle of the hypodermic syringe into the rubber tube conveying the latter) is another potent aid—owing to its stimulating action on the cardiovascular mechanism.

Roentgenoscopy of living subjects and cadavers has shown that **turning the head sharply to the side** generally opens the space between the base of the tongue and the spine, thus enlarging the opening to the air passages. Then giving **oxygen** materially promotes resuscitation. Wauer (Zent. f. Gewerbehygiene, Aug., 1920).

That the "primary signs of death" are all unreliable is maintained by the writer, who advocates application of resuscitative measures in all cases of apparent death until cadaveric rigidity or death spots appear. In restoration of the circulation **cardiac massage** is important. The **Sylvester method** is the only procedure of artificial respiration which assists in emptying the heart, according to the writer's experiments. O. Bruns (Klin. Woch., Dec. 24, 1923).

Advantages of the **Schäfer (prone pressure) method** emphasized. It is the least laborious to the operator and the risk of damage by overexertion is small. It was found to yield an air exchange of 6760 c.c. per minute, as against the natural 5850 c.c. and the 2280, 4030 and 3300 c.c. afforded by 3 other methods. All machines for artificial respiration should be discarded in

favor of the more physiological manual methods. F. W. Pinneo (Jour. Med. Soc. of N. J., Oct., 1924).

A new procedure for artificial respiration, asserted to be superior to all others by reason of the greater air-intake, has been described by E. Seaborn (Lancet, July 19, 1924). A man stands on each side of the patient, with palms held upward; each grasps very firmly with both hands the anterior axillary folds. The upper hand passes deeply into the axilla and takes a broad hold of the pectoral muscles. The other hand grasps the anterior axillary fold as low on the chest as possible. Traction is then applied in both an upward and outward direction until the thorax is lifted from the table and its lower part is fully expanded. A long blast of air is heard to whistle through the larynx for several seconds; only on its completion is the traction discontinued. In this method both the upper and lower thorax are expanded, the diaphragm being pulled out flat by the lateral traction. To aid expiration pressure is applied through the operator's hands to the chest-wall, but the grasp on the axillary folds need not, during this movement, be relaxed. If necessary the procedure can be carried out by 1 man standing at the patient's head, but is not then as efficient, as the outward pull cannot be made as forcible. Tests showed a flow of air in the lungs of 200 c.c. with each movement.

In the *suspended animation due to electric currents*, S. Jellinek (Wien. klin. Woch., Nov. 22, 1923) lays stress on very early and very protracted application of **artificial respiration** as being indispensable for good results. In 2 cases of sudden collapse and disappearance of all signs of life due to electric currents, artificial respiration was kept up for 1 and 3 hours, respectively, until finally spontaneous breathing returned. During the artificial respiration great care should be taken to see that the tongue is kept in its normal position, being pulled forward if necessary, since proper *respiratory ventilation is coupled with favorable pressure effects on the circulation*. **Lumbar puncture**, with the patient lying on his side, should be carried out to relieve the spinal fluid pressure, which is frequently increased, before any injections of **caffeine**, **adrenalin**, etc., are administered.

Cardiac Massage.—This is another valuable measure in resuscitation in certain cases. It has already been considered at length in Volume III, pp. 196-199 (*q.v.*). Suffice it here to add that, in its simplest but least efficient form, this procedure may consist merely of rhythmic forcible compressions of the heart with the closed fist through the unopened chest wall, 120 times a minute, this maneuver tending to empty the heart when it is dilated and to create an artificial carotid pulse.

Direct massage of the heart with the hand is far more likely to succeed in restoring the heart's spontaneous beats. Direct massage with a hand passed through the chest-wall is practically limited to cases in which the chest has already been opened by operation or injury. The method of heart massage which has most often been used in successful resuscitation is the abdominal method, in which the hand is passed into the abdomen through either a preëxisting laparotomy wound or an opening made especially for the purpose. The simple **subdiaphragmatic method** of heart massage from the abdomen should be tried first, but if not successful very soon, is advantageously replaced by the **transdiaphragmatic method**. For this purpose, usually the diaphragm has been incised in an approximately anteroposterior direction, with interference, as pointed out by T. C. Bost (*Surg., Gyn. and Obst.*, Feb., 1923), by the stomach and left lobe of the liver, risk of injury to the musculophrenic artery, and some difficulty in later resuture of the diaphragm and pericardium. Bost advocates, instead, cutting the fibers of the diaphragm near their insertion for a distance of 2 inches, beginning 1 inch to the left of the median line. With the hand passed into the chest through this opening to massage the base of the heart, the pericardium is not opened, no vessels are injured, and the parts fit snugly about the operator's wrist so that air is not sucked in. The incision in the diaphragm is easily closed with continuous catgut. The massage consists of gentle compression of the heart at $\frac{1}{2}$ its normal rate until it starts beating.

Bost reported 2 cases of heart failure at operations, with restoration of heart beats after 6 and 25 minutes of suspension, and survival of 14 and 77 hours, respectively

(without adrenalin). Statistics of heart massage in 75 cases showed complete recovery in 21 $\frac{1}{2}$ per cent., and death in $\frac{1}{2}$ hour to 2 or 3 days in 30% per cent. There were but 2 complete recoveries where syncope had lasted more than 10 minutes. Bost agrees with Fisher, Gunn, and Russell that heart massage should be resorted to in any case in 4 or 5 minutes after cardiac arrest, or immediately if the abdomen is already open.

A less extensive but probably less efficient variation of this procedure is merely to thrust a pair of scissors through the central tendon of the diaphragm, open the scissors and withdraw them, insert 2 fingers through the opening, and press the heart against the posterior chest wall, forcing the blood in the left ventricle into the aorta and thence into the coronary vessels.

Intracardiac Adrenalin (Epinephrin) Injection.—Among the most brilliant results obtained in attempts to reëstablish the circulation after cardiac arrest have been those procured by this measure. So powerful is the stimulant action of this drug on the heart-muscle, that restoration of the contractions has been obtained as long as 20 minutes after they had ceased. The possibilities, as well as the limitations, of this procedure will be best understood by a review of the experiences of various clinical observers. From this review the reader will no doubt feel inclined to accept the general conclusion, in relation to this subject, that intracardiac adrenalin injection, properly carried out, is a practically harmless procedure which is effectual sufficiently often to warrant its routine use in cases of apparent death with cardiac arrest.

D. W. Crile (*Surg., Gynec. and Obst.*, Dec., 1922) has given an account of 5 cases in which the procedure was more or less successfully used. One was that of a soldier being operated on for pulmonary gangrene, in whom the heart had stopped under *chloroform anesthesia*. Direct heart massage and artificial respiration were continued for about 15 minutes. About 10 c.c. of 1:1000 **adrenalin** were then injected directly into the left ventricle and the heart squeezed, when it began to beat firmly and vigorously. Artificial respiration was continued for 20 minutes, and **oxygen** then run into the right bronchus,

giving the patient a healthy color in spite of the absence of respiratory movements. The heart later weakened somewhat, but another 10 c.c. of adrenalin restored it to full activity. After about 45 minutes, spontaneous breathing set in. Blood transfusion, 600 c.c., however, was followed by dilatation of the heart, fibrillation, and arrest.

In another case, one of *amputation under spinal anesthesia*, 20 c.c. of adrenalin were injected into the rubber tubing of the infusion apparatus between 5 and 8 minutes after cardiac arrest. Upon vigorous epigastric massage the heart at once began to beat, and the patient lived 3 days, then dying of sepsis.

In the third case, also of *amputation*, 10 c.c. of adrenalin were injected into the basilic vein and washed in with saline solution between 4 and 8 minutes after cardiac arrest. Pulsation began and at once became vigorous, the amputation was finished, and the patient completely recovered.

The fourth case was 1 of *chloroform poisoning*, with the face livid and breathing stopped. Artificial respiration was carried out, and at least 5 minutes later, 2 doses of 5 c.c. of adrenalin were injected into the heart with a lumbar puncture needle in the 4th interspace about 1 inch from the midline, close to the sternal margin. The heart beat at once, and the patient completely recovered, suffering from anginoid pains, however, for 2 days.

The fifth case was that of a man of 72, under *spinal anesthesia for prostatectomy*. The heart and respiration stopped after about 10 minutes. Artificial respiration and extrathoracic cardiac massage were carried out for 15 to 20 minutes. Attempts to inject the heart failed owing to plugging of the needle, so that the 5 c.c. of adrenalin did not enter the heart until after 20 minutes of complete cardiac failure. The heart then began to beat; the pulsations soon became full, hard, and regular, and a few respiratory movements were made. It failed, however, after about 25 minutes, and nothing further was done.

Points emphasized in conclusion by Crile were: Prompt treatment after failure of the usual measures, since after an ischemia of over 8 or 10 minutes the higher centers may be permanently destroyed; blood to

be aspirated to prove entrance into the heart cavity; cardiac massage to follow the injection until contractions are reestablished; a dosage of 1 to 10 c.c. according to the time elapsed since cardiac failure, the age and size of patient, the quality of adrenalin, and the cause of apparent death. The intracardiac injection is quicker than intravenous administration unless the vein is already exposed for infusion; when pressure in the vein is low or absent, it is difficult to enter.

E. Baumann (Schweiz. med. Woch., Feb. 22, 1923) reported 2 cases of recovery after apparent death in *children*. The first was in a child of 6 years with heart failure under *chloroform*. Artificial respiration and massage proving useless, 0.75 c.c. (12 minims) of 1:1000 adrenalin solution was injected into the heart, 4 minutes after cessation of breathing and heart-action. The heart began to contract after 7 seconds. After 4 days of high temperature the child recovered. In the second case, apparent death followed an attack of suffocation in *whooping-cough* in a child of 2½ years. An intracardiac injection of 1 c.c. (16 minims) of 1:1000 adrenalin was made through the 4th interspace. Strong heart contractions returned in 23 seconds, and after fever for 2 days, the child recovered, the whooping-cough soon after resuming its course. In infants, 0.5 c.c. (8 minims) apparently suffices. In adults, up to 1.5 c.c. (24 minims) may be injected, preferably in the 4th interspace, at the upper border of the 5th rib, about 5½ cm. (2½ in.) from the left border of the sternum.

A case of prompt resuscitation in an infant of 6 months, apparently dead under *ethyl chloride and ether anesthesia*, was recorded by J. Exalto (Ned. Tijds. v. Gen., Mar. 17, 1923). The dose was 0.7 c.c. (11½ minims).

Bodon (Lancet, Mar. 24, 1923) reported a case of complete heart arrest ascribed to *coronary stenosis* in a probable syphilitic of 56 years, in which prompt injection of 1 c.c. (16 minims) of adrenalin into the right ventricle through the fourth left intercostal space exactly at the sternal border was followed by complete recovery. He collected 90 cases of adrenalin injection with lasting recovery in 24. He advises against waiting longer than 5 to 10 minutes after